CHARLETON

HUMAN NATURE

1680

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*March* 25. 1679.

ORdered, That Dr. *Charleton*'s late *Anatomical Prælections* in the THEATRE of the Colledge of Physicians in *LONDON* be Printed.

*John Micklethwait*, President.

Printed for Robert Boulter at the Turks head in Cornhill against the Exchaing 1680.

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# ENQUIRIES INTO Human Nature, IN VI. Anatomic Prælections IN THE New THEATRE of the Royal Colledge of Physicians in *LONDON*.

BY WALTER CHARLETON, M. D. and Fellow of the same Colledge.

Publish'd by Order of the Most Learned PRESIDENT.

*Furori ac dementiæ proximum est, suprema inquirere, & aliena perscrutari, iis ignoratis quæ sunt in nobis.* Socrates.

*LONDON*,
Printed by *M. White*, for *Robert Boulter*, at the *Turks Head* in *Cornhill*, over against the *Royal Exchange*. 1680.

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Right Worſhipfull

# Sr. JOHN CUTLER,

Knight and Baronett.

WHatſoever Sacrifices Men have at any time offer'd up to God, they had firſt receiv'd from His Bounty: nor were they therefore the leſs Acceptable to Him, if offer'd with humility, gratitude, and ſincere devotion. I have reaſon then to hope (*Noble Sir*) that this *Book*, which I now bring as an Oblation of Honor to your *Name*; and bring with grateful ſenti-

ments of your exemplary Munificence so happily exercis'd upon our Illustrious *Colledge* of *Physicians*; will not be the less acceptable to You, because it is already *Yours*, by unquestionable right.

I call it *Yours*; because, though it be an abortive Child of my weak brain, 'twas begotten by a Conjunction of my Obedience to the Command of our Most Worthy *President*, with my honest Ambition to contribute my Mite toward the advancement of the Noble *Art* of *Dissection*, to which You have given so ample Encouragement: because 'twas born in Your *Magnific Theatre*, at the Inauguration thereof: and because it now comes abroad into the World with no other aim, but publickly to acknowledge Your *Heroic Beneficence*.

Nor do I indeed know any other way of making that Acknowledgement, so agreeable either to the *Generosity* of Your *Mind*, or to the *Nobility* of Your *Design*, in erecting the *Anatomic Theatre*; as this I have taken, is.

For, to Your *Great Spirit*, 'tis much more delightful to accumulate Benefits, than to receive Thanks and Eulogies from Your Beneficiaries: and You are alwayes best pleas'd with those acts of Your Charity, which are done

done in *ſecret*, and which are not otherwiſe to be known, than by the light of their own *Merit*. Whence it is, that Your *Liberality* walks in paths new and remote from the Common rode, yet direct, and leading at length into moſt ſpatioſe fields of public Utility, where induſtrious Men may reap a more plentiful harveſt of rewards, than they can at firſt expect: and that the ſtreams of Your *Goodneſs* reſemble thoſe Rivers, which, though running under ground, diffuſe fertility to whole Countreys and Provinces through which they paſs. Of this, the *Mechanic Lecture* You have founded in *Greſham* Colledge, for the promotion of *Manual* Trades; and Your *Anatomic Theatre*, are illuſtrious *Examples*, worthy the imitation of Good Kings, and the envy of Bad: being Both ſo deeply founded upon *Wiſdom*, that the Advantages they promiſe, are of Univerſal concernment to the preſent Age, and (if Men be not wanting to themſelves) cannot but extend to all in Ages to come; rendering their Uſefulneſs more and more Conſpicuous, the lower they deſcend to Poſterity.

And as for the *Nobility* of Your *Deſign* in the later; that can not be deny'd to be full of Piety toward God, and of Benevolence toward Men.

Of *Piety toward God*; in that it aims at the incitement of even Philoſophers, to make farther reſearches and diſcoveries of the infinite Goodneſs, Wiſdom, and Power of God, diſcernable in all his Creatures, but more eminently in the admirable fabric of Man's Body: and by conſequence, to encreaſe their *Love* and *Veneration* of the Divine Majeſty. For moſt certain it is, that profound Contemplation of the Works of Nature, is of it ſelf powerful enough even to compell Human Reaſon to admire, love, praiſe, and adore the Tranſcendent Perfections of the *Author* of Nature; that we are all naturally diſpoſed to form in our Minds ſuch *Notions* of the Deity, as are proportionate to the diſcoveries we make of the Excellencies thereof, in the Objects we contemplate; and in fine, that our *Devotion* toward the ſame Deity, is alwayes proportionate to thoſe Notions. Hence doubtleſs it was, that the moſt inquiſitive *Naturaliſts* amongſt the Antients, were alſo the greateſt Celebrators of the *Supreme Being*: and that the Indian *Gymnoſophiſts*, the Perſian *Magi*, the Egyptian *Sacrificers*, the Gallic *Druids*, and the Athenian *Hierophantæ*, were to their ſeveral Nations both *Philoſophers* and *Prieſts*; teaching at once the myſteries of *Nature*, the

duties

duties of *Religion*, and the rites of *Divine Worſhip*. Evident it is then, that Your *Theatre* may be properly enough call'd, a *Temple* of *Natural Theology*, where the *Perfections* of God are ſtudied in the Works of His hands, and His *Praiſes* celebrated with Underſtanding. *Deum enim colit, qui novit.*

Of *Good-will toward Men*; in that it hath provided the fitteſt Means to bring the moſt Antient, the moſt univerſally Uſeful, and therefore the Nobleſt of all Arts, the Art of *Healing*, to Perfection. For, *Anatomy* being the Grand fundament of *Medicine*, and yet (with ſorrow I write it) incomplete; it cannot be, but every new diſcovery thence ariſing to the Learned and Judicious Profeſſors, muſt conduct them, not only to more certain Science, firſt of the true *Oeconomy* of Mans body, in the ſtate of Nature; and then of the diſorders and perverſions of that Oeconomy, by *Diſeaſes*, with their reſpective Seats and Cauſes: but alſo to the moſt rational and propre *Indications*, for the preſervation of *that*, and the cure of *theſe*. Nor can You think me to ſpeak rather from affection or partiality, than from right judgement; if I affirm, that no Men are more likely to make ſuch Diſcoveries by accurate Diſſections, than

ſome

ſome of the now flouriſhing *Fellows* of our Colledge are : ſo great are the Teſtimonies they have already given to the World of their unwearied *Diligence*, ſolid *Erudition*, and admirable *Sagacity* of Spirit. So that 'tis not eaſie for me to determine, whether theſe Gentlemen be more Worthy of Your Theatre, or Your Theatre more Worthy of them. But of this I am ſure, that *ſuch* a Theatre hath been moſt fitly conjoyn'd to *ſuch* a Colledge: and I dare propheſie, they will mutually add more and more Honor each to the other.

Now (*Honor'd Sir*) if You pleaſe to reflect upon what I have ſaid, of the Generoſe Temper of Your *Mind*, and of the Wiſdom of Your *Deſign* in this Magnificent Structure; You will (I preſume) be ſoon induced to believe, what I before affirm'd, that I could give no teſtimony of the great Reſpect and Gratitude I owe You, more decent and congruous to *Both*, than the Dedication of theſe my late *Anatomic Prælections* to You is, in which (how imperfect ſoever) I have ſhewn my ſelf willing at leaſt, and Zealous to be ſerviceable to Your *End*, without offending Your *Modeſty*.

The Reaſons I have brought, ſeem ſufficient, both to evidence the *Right* this Book hath to Your *Favor*, and to juſtifie my *Election* of it,

as

as the leaſt indecent Sacrifice I could offer to Your *Glory*: and the ſame may ſerve alſo to incline You to receive it benignly, as a *ſpecimen* of my *Devotion* to ſo Eminent a Benefactor; and to permit me to expoſe the ſame to the Cenſorious World, under Your Auſpicious *Patronage*; which will certainly afford it *defenſe* from Contempt, and might alſo give it *long Life*, were it not of an infirm conſtitution, as having been form'd in haſte, and in the declining age of its Author, and,

*Noble Sir,*

*Your moſt ſincerely devoted, humble ſervant,*

March the 27th
*A. D.* 1679.

WValter Charleton.

# Advertisement.

LEst the Errors *of the Press* (*which yet are neither many, nor great*) *be imputed to the* Author, *who wanted leisure to prevent them*; *the* Reader *is civilly desired to correct them thus.*

In Page 19. Line 26. of the *Preface*, read, *of one and the same part*: p. 26. l. 30. of the *Preface*, r. *Trismegistus in Asclepio.*

In the Book.

Pag. 23. l. 31. r. *Pelican and most other fowls*: p. 52. l. 19. r. *betwixt it and the second or middle coat*: p. 130. l. 20. r. *spontaneous*: p. 132. l. 13. r. *and is not only convenient*: p. 421. l. 19. r. διαχωρίζεσθαι. p. 430. l. 11. r. ἀλλὰ κ᾽ ἔγω ——p. 436. l. 2. r. κ᾽ κινέειν——p. 437. l. 31. r. *purification of the bloud*: p. 438. l. 1. r. *or not yet despoiled of its spirits*: p. 473. l. 26. r. πίπονα φαρμακεύειν· p. 478. l. 7. r. *which threatning a flux*: p. 498. l. 5. r. *a force by transmission*: and l. 16. r. *of such a power*: and l. penult. r. *framed*: p. 502. l. 25. r. *Kingdom of Fairies*: p. 505. l. 20. r. *Philosophy*: p. 513. l. 24. r. *arise*: p. 515. l. 22. r. *divine Wit*: and l. 33. r. *so like a bogg*: p. 519. l. 9. r. *Caspar Barlæus*: p. 544. l. 25. r. *coadjuvantesq; omnium operas.*

PRÆFACE.

# PREFACE.

## OF THE
## Antiquity, Uſes, Differences, &c.
## OF
# ANATOMY.

THIS Place *is ſacred to the ſtudy of God's Works, for the benefit of Mankind; the* Occaſion *of this Aſſembly, rare, inaugural, and worthy of the greateſt ſolemnity; the* Aſſembly *it ſelf, frequent, and conſiſting (for the major part) of Men Noble, Wiſe, Learned and Curioſe; and my* talent, *but a* mite. *Highly then it concerns me, before I advance one ſtep, to ſtand ſtill, a moment or two, and ſeriouſly conſider, what my* Subject *is, and what my* Province.

*My* SUBJECT *is, the moſt abſtruſe* Oeconomy *of Nature in the body of Man; a Syſtem of innumerable ſmaller* Machines *or Engines, by infinite Wiſdom fram'd and compacted into one moſt beautiful, greater* Automaton: *all whoſe parts are among themſelves different in their ſenſi-*



*ble*

*ble elements, in their magnitudes, figures, positions, textures, motions, actions and uses; yet all ordain'd and adjusted to one common End, namely, to compose a Living* Ergasterium *or Work-house, in which a* Reasonable *and* Immortal Soul *may, not only commodiously, but also with delight, exercise all her divine Faculties, to her own felicity, and to the praise and glory of her* Omnipotent Creator. *A Subject (as ye,* Noble and most judicious Auditors, *will all readily acknowledge) admirable even to astonishment; full of* variety, *and no less full of* wonders: *a Subject, wherein the most acute and piercing Wits have found more, much more to* amuse, *than to* satisfie *their Curiosity; and which hath forced them, after all their anxious disquisitions, to sigh forth that pious Exclamation of King* David, Quàm admirabili nos structurâ Deus formavit!

*My PROVINCE is, the* Anatomic Administration *of these ruines of a Man,* i. e. *to take asunder some few at least of the various* Organs *of this Master-piece of the Creation, so that we may explore their several conduit-pipes, their springs, movements, actions, communications, offices, in fine, their whole* Mechanism *or Construction, upon which their respective Functions necessarily depend. For, most certain it is, that the* Divine Architect *hath fram'd all things, as in the Greater World, so likewise in this* Microcosm, *in* number, weight, *and* measure: *and we have it, as a precept, from our Oracle* Hippocrates (lib. περὶ Εὐχημοσύνης) *that a genuine Physician ought* [πᾶν τὸ ὑποδειχθὲν ἐκφέρειν] *to evince whatsoever he delivers as doctrine (if it be possible) by* demonstration.

*These things consider'd, I appeal to You,* Most Prudent *and* Venerable President, *who have been pleas'd, from Your good opinion, not of my sufficiency, but only of my* diligence, *this day to place me where I deserve not to sit; and to You, my* most Learned Collegues *of this* Illustri-

ous

ous Society, *who honour me by your presence: whether it be not necessary for me to set before you, in a short* Proem, *some at least of the many sentiments I have conceiv'd in my mind, of the singular* Dignity *and* Excellency *of the task assign'd me. When by so doing, I shall at once pay some part of the debt I owe, both to the honour of this* Temple of Philosophy, *in which we now sit; and to the* Solemnity *of this* Convention: *and shew my self, however unfit worthily to administre so noble a Province, yet duely conscious of the* weight *of it; which may perhaps somewhat conduce to render my faileurs the more* Venial.

*That I may therefore both invite your* Attention, *and pre-ingage your* Candor; *I ask leave to make my self, for a few minutes, your* παραινέτης *or* Remembrancer, *by recalling into your memory, what ye have heretofore read, in the monuments of the Antients, concerning the* Antiquity *of the* Art of Dissection; *and what ye have, from your own happy Experience and Observation, collected, touching the great and manifold* Utility *of the same. Which, I shall endeavour to do, with as much of* Perspicuity, *as the Umbrage of the Argument, and the Scantness of my Readings will permit; with as much of* Conciseness, *as can be brought to consist with that Perspicuity.* ¶.

*As for the* ANTIQUITY *of* Anatomie; *that doubtless is, if not equal, yet not much inferiour in age to* Medicine *it self, which seems to have been invented by men in the very infancy of the World. For,* (1.) *If* Necessity *be, as hitherto on all hands it hath been admitted, to have first suggested to Man all those profitable inventions, whereby Humane life has been render'd either more defensible, or more comfortable: we may with good reason infer, that the Art of* Medicine, i. e. *of preserving and restoring health, had its beginning as early in the morning of Time, as any of the rest: it being certain that mens bodies were*

*then not only liable to, but actually infested with various distempers, pains, infirmities and other maladies; the Laws and Constitutions of Nature continuing perpetually the same: and no less certain, that men observing what things were agreeable, what disagreeable to the body, what mitigated, what exasperated their maladies, were by the very dictates of Reason taught to provide for the conservation of their Health, by abstaining from things noxious, and for the restitution of it when impair'd, by using things convenient and beneficial; as the* Divine old man *of* Coos *hath with admirable sagacity observ'd in his excellent Book* περὶ Ἀρχαίης ἰητρικῆς. *Now if Medicine be so antient, 'tis highly probable, that* Anatomy, *which is the principal fundament thereof, is not much less antient, if not equal. Could Men (think ye) feel themselves tormented in any member or part of the body, or unable to use the same in the actions to which it was originally destin'd and comparated, and which it had with facility and indolency alwayes perform'd before; could they (I say) be sensible of this, and at the same time not highly solicitous to know in what part of that disaffected member the pain or defect chiefly lay, what piece of the Organ had been broken, stopp'd, displaced or otherwise vitiated, so as to discompose the whole frame, and make it unfit to execute its proper functions? Or how was it possible for them to acquire this knowledge, unless by first acquainting themselves with the natural composition of that same member,* i.e. *with the various similar parts whereof it is made up, with their several constitutions, sizes, figures, textures, positions, connexions,* &c. *in fine, with the whole* Mechanical *ration of the organ, upon which its aptitude to perform its proper actions necessarily depends? But this they never could do, otherwise than by dextrous* dissection *of that member in the body of some one or more defunct. I ghess therefore, that the Art of* Dissection *and that of* Medicine *were Twins, that had Humane* Wit *for their Father, and* Necessity

sity *for their Mother: and* (2.) *That they neither were born in* Grece, *nor are so young by a thousand years, as even most Antiquaries themselves have concluded them to be. For, tho' that great devourer of its own productions,* Time, *hath consumed the greatest part of the monuments of the younger world; leaving us very few, and those too imperfect, full of chasms and decayes: yet I am able to prove, from the records of an* Author *or two of unquestion'd credit, and venerable antiquity, that both are much elder than most Learned men have, after long raking in the rubbish of old* Athens, *determin'd them to be.*

*It is not unknown to the Learned part of this assembly, that* Ptolomæus Philadelphus *King of* Ægypt, *a Prince of a curious spirit and large heart, finding in the immense treasure of Books he had collected and stored up in his Library, the Histories of most other Nations, but none of his own the* Ægyptians; *to supply that defect, imploy'd one* Manetho, *a man of solid Erudition, a Priest and Master of the Rolls kept in the Temple of* Memphis, *to compose a History* de rebus Ægyptiacis, *from the first original of that mighty people, down to his own times: and that accordingly* Manetho, *consulting the antique Volumes of* Mercurius Secundus, *which had been many hundred of years preserved in the most sacred recesses of the Temple, and the more antique* Hieroglyphic Marbles, *compiled out of them a true History of* Ægyptian Antiquities; *a Book, whose loss all Learned Chronologers lament, whose dispers'd fragments they religiously venerate. From this Book,* Syncellus, *an excellent Chronographer, who flourish'd in the year* 800. *after our Saviours Nativity, is said to have transcribed whatever he wrote in Græc in his so much admir'd work, concerning the* Dynasties *of the Kings of* Ægypt, *and other Antiquities of that Nation; which our most profound Reformer of the vulgar Computation of Times, Sr.* John Marsham, *thus commends.* Quicquid supellectilis hodie supereſt ad in-

ſtaurandas Ægyptiorum origines, id fere totum debetur *Syncello*; neque tanti ſunt momenti quæ *Herodotus* omnium primus, aut illum ſecutus *Diodorus Siculus*, de Regibus Ægypti tradiderunt.

Pag. 54. c. *This* Syncellus, *among many other memorable things recounted of the Ægyptian Kings of the firſt Age, delivers, That after the deceaſe of* Menes, *firſt King of the* Thinites, *Son of* Cham, *Founder of* Memphis, *call'd by the Hebrews* Ham, *by the Ægyptians* Jupiter Hammon; *Ægypt came to be divided into two Kingdoms,* Thebes *and* Memphis: *this, under* Athothes *or* Mercury; *that, under* Toſorthus *or* Æſculapius; *both after honor'd with Divine titles and worſhip. Then commemorating the virtues and merits of theſe two Kings, he ſaith of* Mercury, τὰ ἐν Μέμφει βασίλεια οἰκοδομήσας, ἔ φέσιν βίβλοι ἀνατομικαί· ἰατρὸς γὰρ ἦν:

P. 56. 6. he built a palace in the City of *Memphis*, and wrote Books of Anatomy; for he was a Phyſician: *of* Æſculapius, ἔτι δὲ Ἀσκληπιὸς Αἰγυπτίοις καὶ τὴν ἰατρικὴν νενόμισται, &c. he is held to be *Æſculapius* by the Ægyptians for his skill in Medicine; and he found out the art of building

Stromat. lib. 1. p. 634. b. with ſquar'd ſtones. *This Record is atteſted alſo by* Clemens Alexandrinus, *an Author of no leſs credit, and near upon ſix hundred years elder than* Syncellus, *who ſaith expreſly*; Ex 42. Mercurii Libris, 36. ad Ægyptiorum Philoſophiam, 6. reliqui ad artem Medicam pertinent; quorum primus fuit Anatomicus, περὶ τῆς τοῦ σώματος κατασκευῆς, de conſtructione corporis.

*I am not ignorant, that ſome great Scholars of this our Age, hold it more probable, that the Art of* Anatomy *here attributed to* Mercury *the* firſt, *was the invention rather of his equal* Æſculapius, *who is eſteem'd* πολυθρύλλητος Medicinæ Autor. *But ſince theſe ſame Critics deny not* Mercurius *and* Æſculapius Ægyptius *to have been Contemporaries; it makes no difference, as to the Antiquity of* Anatomy, *which chiefly we are now ſeeking, to which of the two*

*the*

*the glory of its first invention be ascrib'd. Let others then contend about this nicety, while we remarque, that from the Texts just now recited, three considerable things are evident.*

(1.) *That the* Ægyptians *have a just and clear right to the honor of the invention of the noblest of all Arts,* Medicine: *and therefore* Pliny *did them no wrong in saying,* non immeritò Medicinam Ægyptii apud ipsos volunt repertam fuisse; & *Æsculapius Memphites* inter primos hominum numeratur, qui opinione humanâ Dii facti sunt. Nat. Hist. l. 29. c. 2.

(2.) *That the most useful inventions of the first of Historical Times, were* Medicine *and* Architecture: *one to furnish mankind with helps against infirmities of the body, the other to defend him from injuries of the air: both suggested by* Necessity. Hinc quippe præmaturum medicandi ædificandique studium.

(3.) *That this our* Ægyptian Æsculapius *was one thousand years elder than the* Æsculapius *of the* Græcs, *who was of* Epidaurus, *and there for many hundred years worship'd with solemn rites and religious devotion, as the God of Health. For,* Clemens Alexandrinus *casteth the* Apotheosis *or Consecration of this* Æsculapius Epidaurius *into the fifty third year before the sackage of* Troy: *telling us from* Apollonius *the* Rhodian, *that he accompanied* Jason *in his voyage. Which, tho' the name of* Æsculapius *be not found in* Apollonius *his list of the* Argonauts, *is yet probable from the consent of Times: for* Machaon, *son to the same* Æsculapius, *is by* Homer *numbred among the noble Græcians that bore arms at the siege of* Troy. Iliad. β. Stromat. l. 1. p. 322.

Τῶν αὖ δ' ἡγείσθην Αἰσκληπιοῦ δύο παῖδες,
Ἰητὼ ἀγαθὼ, Ποδαλείριός τε ἠδὲ Μαχάων:

Quos duo ducebant, Medicorum principe nati,
Præstantes Medici, Podalirius atque Machaon.

So

*So that if we compute from the ſecond King in the firſt* Dynaſtie *of the* Ægyptians, *down to the fifty third year precedent to the* Excidium Trojæ, *we ſhall find the intervenient ſpace of time to amount to about a thouſand years. Of ſo much greater antiquity is the firſt Inventor of* Medicine *among the Ægyptians, than that* Æſculapius *to whom the* Græcs *erroneouſly or arrogantly aſcribe it, and of whom* Lactantius *ſaith,* quid fecit aliud divinis honoribus dignum, niſi quòd ſanavit Hippolytum?

Lib. 1. cap. 10. inſtitutionum divinar.

*This I have noted, only to ſhew the great Antiquity of my Profeſſion, not to detract from the renown of the* Græcian Æſculapius, *who being alſo excellent in the Art of* Medicine, *augmented the honor of it in his own Nation; and therefore deſerves from me the incenſe of a little breath in ſacrifice to his memory. Give me leave then, I pray, to ſpeak a few words concerning him, toward the ſatisfaction of thoſe among my* Auditors, *who perhaps have been leſs converſant in Books. At* Epidaurus *a City in* Argolis *or* Argia (*at this day call'd by ſome,* Saconia, *and* Romania Moreæ *by others*) *ſituate near the* Ægean *ſea, he was worſhip'd as a Divine* Numen; *having there erected to him a magnific Temple, in which the Sick, after due oblations, were lay'd to ſleep, and ſaid to be ſecretly taught by the* God *himſelf in their dreams, by what remedy they might certainly be heal'd. This is more fully deliver'd by* Pauſanias: *and* Strabo *reports farther, that among many others in that place and manner reſtor'd to health, one* Archias, *ſon of* Ariſtæchmus *of* Pergamus, *was freed from dreadful Convulſions in all his limbs, only by following the counſel of his dream: and that returning to* Pergamus, *ingratitude he brought with him the religion and worſhip of the Epidaurian Temple, building another in imitation of it.* De quo templo etiam *Corn. Tacitus* (*Annal.* 3.) in aſylorum apud Græcas civitates antiquitùs conſtitutorum origines inquirens, hæc habet: "Conſules apud Pergamum "Æſculapii

Lib. 2.

Lib. 8.

"Æsculapii compertum asylum retulerunt: cæteros ob-
"scuris ob vetustatem initiis niti. *From* Pergamus *the same Superstition was in process of time transferr'd also to* Smyrna, *and a third Temple rais'd there: in which one* C. Claudius Valerius Licinnianus *was Chief Priest; as appears from a Marble not long since brought from* Smyrna, *and now extant in the* Sheldonian Theatre *at* Oxon. *in number the forty sixth Marble.*

*The testimonies I have brought, are (you see) authentic; nor can you longer doubt, that among the few reliques of the younger world that have escap'd the jaws of Oblivion, some are yet extant to attest the great Age and honor of this pair of Noble Sisters,* Medicine *and* Anatomy. *So solid were their Principles, so durable have been their Constitutions, so illustrious their Propagators, so sacred their Records, and (if I may be permitted to speak as a* Platonist) *so powerful a* Genius *has preserv'd them.* ¶.

*Was Anatomy then taught by the Founder of* Memphis? *Is it by a whole Age at least elder than the eldest of those mountains of brick, or as* Diodorus Siculus *vainly calls them,* Ἀΐδιοι οἶκοι, Eternal Habitations, *the Ægyptian* Pyramids? *And has it from that time to this day continued in use and esteem among wise men wheresoever Letters and Civility have flouriſh'd? This certainly, is alone sufficient to evince the great* UTILITY *of it, were all other arguments wanting.* "For, *Human Inventions, however sub-*
"*til and grateful at first to the Curious, are never long-*
"*liv'd, unless afterward they be found useful also and*
"*beneficial to Mankind. But in what do's the* Utility *of it consist? In so many things, I want time to enumerate them, and must therefore content my self to touch only two or three, such as lye most open and obvious even to vulgar observation. I say then, that the study of* Anatomy *is singularly profitable to a Man, in respect of* Himself, *in respect to*

Lib. 4. c. 169.

God, *in respect of the Divine Art of* Healing: *each of which requires to be singly consider'd.*

(1.) *In respect of* Ones-self. *That* Apollo, *when from his Delphic Oracle* (*as* Plato *in his* Alcibiades *relates*) *he deliver'd that most wise precept,* γνῶθι σεαυτὸν, Know thy self, *thereby implicitly injoyn'd the study of* Anatomy; *is more than I shall venture to avouch; but this I dare boldly affirm, that no Mortal can attain to any profound knowledge of* Himself, *without long and strict scrutiny into the mysterious Oeconomy of Human nature; which can be no otherwise made, than by the helps and light of* Anatomy. *Of the simple* essence *of the Rational Soul, we seem in this umbratil life uncapable to know much. For, She being, as Wise men teach, and most of us believe, a pure* Spirit; *we can have of her no idea or image in our Phantasie, and consequently no Notion: all our Cognition being built upon Idols or Images stamp'd in the mint of Imagination; and all our Reasonings or Discourses, nothing but connection of many of those Images into chains, sometimes of more, sometimes of fewer links. We cannot therefore deny our ignorance of the nature of that noblest part of our selves, from which we derive all our little Science: and must be content to entertain our irrequiet Curiosity with the faint glimmerings of light, that shine through the acts and operations of that Celestial Ghest in our frail and darksom Tabernacles of flesh. What then remains to be known by us of our selves? Nothing, I think, but the* Divine Architecture *of the Body, the fabrique of the various Organs, by which the Soul acts, while she sojourns in it: and these* (*ye know*) *are not to be understood but by dissecting and distinctly contemplating the several parts of each Organ, so as to investigate the Mechanical reason of its aptitude to its proper motions, actions and uses.*

*Doth any man here conceive, that the Oracle is to be expounded only of the* Passions *of the* Mind, *and the Art of moderating*

*moderating them by the dictates of Prudence, and rules of Virtue? I say, that neither is the knowledge of the* Passions *to be acquir'd without frequenting the Scholes of* Anatomists. *For, the* Passions *seem to be in the general, only certain Commotions of the Spirits and bloud, begun in the seat of the Imagination, propagated through the Pathetic nerves to the heart, and thence transmitted up again to the brain: and therefore whosoever would duly enquire into their nature, their first sources and resorts, their most remarkable differences, tides, forces, symptoms,* &c. *will soon find himself under a necessity to begin at Anatomy, thence to learn the course of the bloud, the structure of the brain, the origin and productions of the nerves, the fabric of the heart with its pulses, and the wayes by which a reciprocal communication or mutual commerce is so swiftly effected, so continually maintain'd betwixt the Animal and Vital machines. Otherwise, how highly soever he might think of his own speculations, he would hardly be able clearly to solve any one of the* Phænomena *of this or that particular Passion; for instance, whence it is, that* Blushing *is the proper sign of* Shame, Paleness *the Character of suddain* Fear, Sadness *the inseparable concomitant of* Hate, & sic de cæteris. *In a word, he would as soon be at a loss in tracing the intricate Labyrinth of Human Affections, as a blind man that should undertake to give the Chorography of a whole Countrey, meerly from a relation of some memorable action done in some part of it.*

*Nor should I believe such a man half so likely to temper and compose the tumults of his inordinate Passions, as a skilful Anatomist, who understands, by what impressions they are occasion'd, upon what parts of the brain those impressions are made, what sympathy and confederation Nature has instituted between those parts and the Cardiac nerves, how those nerves divided into innumerable fibres contract the ventricles of the heart, and how that Contraction, accor-*

*ding to the various degrees of its force and velocity, neceſ-ſarily impells the blood more or leſs copiouſly and violently through the arteries into the parts moſt concern'd in the Paſ-ſion at that time moſt urgent. For, certainly, he that hath the advantage to underſtand all theſe things, is better in-ſtructed to appeaſe the impetuous Commotions at any time rais'd within his breaſt, by reducing the rebellious appetites of his inferior Faculties to obedience to the contremands of his Superior or Reaſon; in which one thing the ſumm of all* Moral Philoſophy *conſiſts, and which advanced into a* Ha-bit, *becomes* Virtue *it ſelf. So that take the Counſel given by* Apollo, *in which of the two ſenſes ye like beſt,* viz. *ei-ther as directing to learn the admirable* frame *of the* Body, *or as intimating that wiſdom conſiſts chiefly in the* regula-tion *of the* Affections; *ſtill the ſtudy of* Anatomy *will be requiſit to acquiring the Knowledge of* Ones-ſelf.

(2.) *Requiſite it is alſo to conduct even a* Naturaliſt *to the Knowledge of* GOD. *I mean the knowledge of not only the* Exiſtence *of a Supreme Being in the World, but alſo of his* Eternity, *omnipotent* Power, *infinite* Wiſdom, *and inexhauſtible* Goodneſs; *for as to the* Divine nature *it ſelf, that we muſt all with holy aſtoniſhment confeſs to be to Human Underſtanding* incomprehenſible; *for, how can a* finite *have an adæquate notion of an* Infinite? *Moſt true it is indeed, that there are in every part of the Univerſe certain marks or impreſſes of a* Divine *hand; and the ſmalleſt Inſect that creeps upon the earth, the very graſs whereon we tread, yea, even things* Inanimate *proclaim the Glory of their Maker, inciting us to venerate, praiſe and adore Him: ſo that St.* Paul *preach'd true Natural Theo-logie to Infidels, when he taught, that* the inviſible things of God are known by the viſible things of his Creation; *and* Heraclitus *gave a memorable hint of his piety toward the* Summum Numen, *when inviting into his poor ſmoaky cottage ſome proud ſtrangers that diſdain'd to put their*

heads

*heads under ſo vile a roof* ; Enter, *ſaid he*, nam etiam hîc Dii ſunt, *here alſo are Gods. And in truth, every page in the great Volume of* Nature, *is full of real* Hieroglyphicks, *where* (*by an inverted way of Expreſſion*) things *ſtand for* words, *and their* Qualities *for* Letters. *Whence perhaps* Plato (in Timæo) *took a hint of that ſublime thought of his, that* the World is Gods Epiſtle written to mankind. *But if we ſurvey the Epitome of the World, the Temple of* Mans *Body, in which as in a Model or Exemplar, all parts of the Greater World are repreſented in little* ; *we ſhall there find ſomething more auguſt, more Majeſtical. Who can obſerve, that ſo magnificent a pile is rais'd only* è luto, *out of a little ſlime* ; *that from a few drops of the* Colliquamentum *or Genital humor, of a ſubſtance Homogeneous or ſimple, are formed more than two hundred bones, more Cartilages, very many ligaments, membranes almoſt innumerable, myriads of arteries and veins, of nerves more than thirty pair with all their ſlender branches and continued fibres, near upon four hundred muſcles, a multitude of glandules, and many other parts, all divers each from other in ſubſtance, conſiſtence, colour, texture, fabric*, &c. *Who can, I ſay, obſerve this, without being forced to acknowledg the infinite* Power *of the Divine Architect, who makes the very Materials of his building ? Who can look into the* Sanctum Sanctorum *of this Temple, the* Brain, *and therein contemplate the pillars that ſupport it, the arch'd roof that covers and defends it, the fret-work of the Ceiling, the double membrane that inveſts it, the reſplendent partition that divides it, the four vaulted cells that drain away impurities, the intricate labyrinths of arteries that bring in from the heart rivulets of vital blood to heat and invigorate it, the Meanders of veins to export the ſame blood, the Aqueducts that preſerve it from inundation, the infinite multitude of ſlender and ſcarce perceptible filaments that compoſe it, the delicate nerves or*

*chords*

*chords ſpun from thoſe threds, the original of that ſilver chord* (*as* Eccleſiaſtes *calls it*) *or Spinal marrow, upon which the ſtrength of back and limbs chiefly depends; and many other parts of the wonderful Engine: and not diſcern an infinite* Wiſdom *in the deſign and conſtruction of them? And as for the infinite* Goodneſs *of God; that is no leſs conſpicuous in the connexion of ſo many and various inſtruments into one complex* Automaton, *by which they are ſo admirably combin'd, that every one works for it ſelf and for the public at once; that every one performs its peculiar office apart, yet all co-operate to one and the ſame common end, the ſubſiſtence, ſafety, and welfare of the whole; and that if any one happen to be put out of order or tune, all the reſt ſympathize with it, and the whole Harmony of Functions is diſcompos'd. Add to this ſtupendous Machine an internal Principle to give it life, ſenſe, voluntary motion, and underſtanding: and then ye may ſay with* Cicero; Jam verò animum ipſum mentémque hominis, rationem, conſilium, prudentiam, qui non Divinâ curâ perfecta eſſe perſpicit; is his ipſis rebus nobis videtur carere.

*If then the admirable fabric of our Body demonſtrates the Power, Wiſdom and Goodneſs of the Maker; (whom the Scripture moſt emphatically calls* [Yotzêr Hakkôl] (*the* Former of all things, Jer. 10.16.) *and if it be by the help of Anatomy alone, that we come to contemplate and underſtand the excellency of that fabric: we may ſafely conclude, that to ſtudy Anatomy diligently and reverently, is to learn to know God, and conſequently to venerate Him;* Deum enim colit, qui novit. *After this, what others, out of ignorance, may think or ſpeak to the prejudice of this ſo uſeful Art of Diſſection; I am neither concern'd, nor ſolicitous to know: but this I openly declare, that if I knew an* Atheiſt (*if there can be ſuch a Beaſt in the world*) *I would do my beſt to bring him into this Theatre, here to be*

*ſenſibly*

*ſenſibly convinced of his madneſs. For, ſure I am, that ſome of the Antient Heathens have call'd the ſtructure of Mans Body, the* Book of God: *and that even* Galen *himſelf, an Ethnic too, ſlow of belief, and moſt alien from Superſtition, learn'd ſo much of Piety from diſſections, that in his whole ſeventeen Books* de uſu partium, *he ſings a perpetual Hymn as it were in praiſe of the* Divine Architect *that form'd them. Of which laudatory Hymns I have choſen one, which ſeeming to me more lofty and harmonical than any of the reſt, and more proper for this place, deſerves my recital and your remark. In his* third Book, *contemplating the skin that inveſts the ſole of the foot (a part deſpicable to vulgar eyes) He breaks forth into this rapture of admiration.* Cutem ipſam (*ſayes he*) non laxam, aut ſubtilem, aut mollem; ſed conſtrictam, & mediocriter duram, ſenſilémque, ut non facilè pateretur, ſubdidit pedi Sapientiſſimus Conditor noſter: cui Commentarios ego hos, ceu hymnos quoſdam, compono: & in eo pietatem eſſe exiſtimans, non ſi Taurorum ἑκατόμβας ei plurimas quiſpiam ſacrificarit, & caſias aliáque ſexcenta unguenta ſuffumigarit: ſed ſi noverim ipſe primus, deinde expoſuerim aliis, quænam ſit ipſius *Sapientia*, quæ *Virtus*, quæ *Providentia*, quæ *Bonitas*; ignorantia quorum ſumma impietas eſt, non ſi à ſacrificio abſtineas. Quòd enim cultu convenienti exornavit omnia, nullíque bona inviderit; id perfectiſſimæ *Bonitatis* ſpecimen eſſe ſtatuo: inveniſſe autem quo pacto omnia adornarentur, ſummæ *Sapientiæ* eſt; ac effeciſſe omnia quæ voluit, *Virtutis* eſt invictæ. *A Hymn not unworthy to be ſung, with ſolemn Muſic, even in our Churches.*

(3.) *Beſides theſe two noble uſes of Anatomy, by me now explain'd, there remains here to be conſider'd yet a* third uſe, *not, as the former, common to all mankind, but* proper *to* Phyſicians: *to whom the ſtudy of it is, not only profitable*

*fitable and delightful, as to their private ſpeculations; but alſo neceſſary, as to their well underſtanding the divine Art of* Medicine *which they profeſs. This* Neceſſity *is indeed ſo univerſally known and acknowledged by all wiſe men, that to go about to prove it, would be as ſupervacaneous, as to light a candle to ſhew the Sun at noon: yet becauſe there are ſome, who either blinded with the ſmoak of fallacious* Chymiſts, *or corrupted by ſome private intereſt, perceive it not; give me leave, I pray, toward the diſenchantment of theſe, briefly to ſet before them two or three of the plaineſt cauſes or reaſons that make* Anatomy *the grand fundament of* Medicine.

1. Epidem. Hippocrates (*I remember*) *doth often inculcate to his Diſciples, the genuine Sons of Art, three cardinal precepts, in which the whole duty of a Phyſician ſeems to be comprehended. The* firſt *is,* γινώσκειν τὰ παρέοντα, *to underſtand the preſent ſtate of the ſick, the nature of the malady, and the part affected: the* ſecond, προλέγειν τὰ ἐσόμενα, *to prognoſticate the event of the diſeaſe: the* third, ὑγιέας ποιεῖν τοὺς ἀδενέοντας, *to relieve or heal the ſick. But in all theſe three duties, he that is ignorant of Anatomy, muſt needs be ſhamefully deficient.*

*In the* Diagnoſtic *part, becauſe no good judgment can be made of the nature and kind of any diſeaſe, unleſs it be firſt known, what part of the body is thereby chiefly affected; and the moſt certain* indicia *or diſtinctive ſigns of the part affected, are taken principally from the* ſituation *of the part, and from the* action *of it* hurt. *For inſtance, he that knows the* Liver *to be naturally ſeated in the right* Hypochondrium, *if in that place pain be felt, or ſwelling appear from a Tumor within, will eaſily thence collect, that the Liver is the part then affected: and he that knows, that the principal action of the Stomach is* Concoction, *will ſoon know, if Concoction be hurt, that the Stomach is miſaffected. But both the* places *and* actions *of the parts are*

*learn'd*

*learn'd only from Anatomy: and therefore whoever is ignorant of Anatomy, can have no certain knowledge of either* those, *or* these.

*In the* Prognostic *part he must likewise fail, because the best* Ostenta *or Signs of the future good or evil event of any Sickness, are all derived from these three heads,* viz. *the* Excretions, *the* Action hurt, *and the* Habit *of the body, in colour, figure and bulk: none of all which are to be known without Anatomy: and he is likely to make but an ill Predictor of events to come, who has not skill enough to observe and discern the signs that portend them.*

*In the* Curative *part also he must be equally deficient, because the true and exquisite Method of Healing is grounded upon, and design'd by rational* Indications, *and every Indication is desumed not only from the nature of the Malady, but also from the part thereby affected; and therefore according to the various constitution, temper, site, connexion, sense and other qualities of the affected part, the remedies to be used, ought to be various. And with what face can a Chirurgeon pretend to recompose broken, or restore dislocated bones, who is ignorant of their site, figure, structure, and articulations? Manifest it is then, that whoever pretends to the cure of diseases, and yet remains ignorant of Anatomy; is either an impudent Impostor, or at best a Fool. What then are they, who put their life into the hands of such men?*

*From these nobler Uses of Anatomy in Physic, Natural Theologie, and Medicine now explicated, I might descend to many others, less noble indeed, yet not unworthy the notice and consideration even of Wise men, observable in various inferior Arts, more particularly in those two Arts so highly inservient to Magnificence, Ornament and Delight,* Architecture, *and* Painting, *both which borrow their exemplars, rules, graces, perfection and estimation from the proportions, symmetry and pulchritude of the parts of*

*Mans body. But these being alien from my task, and the hours assign'd me for the performance thereof, being few; I am obliged to pretermit them. Notwithstanding, lest I should by mentioning them* en passant, *excite in some of my ingenioſe Auditors of the Yonger sort, a curiosity which I have not now leisure to satisfie: 'tis fit I should refer them to two or three Authors of good note, to be by them fully inform'd how requisite the study of the fabric of mans body is to all who desire to excell in either of these Arts. For* Architecture *then, I would direct them, first to* Vitruvius, (*who* in lib. 3. cap. 1.) *laying this down for a fundamental Maxim;* non potest ædes ulla sine symmetria atque proportione rationem habere compositionis, nisi uti ad Hominis benè figurati membrorum habuerit exactam rationem; *and immediately after measuring the proportions that the several parts of a well-shap'd Man hold one to another; proceeds to commensurate the parts of sacred Ædifices or Temples by the like proportions: and (*in lib. 4. cap. 1.*) treating of the Columns of the three Orders, expresly derives the dimensions of those of the* Tuscan *Order, with their bases, diminutions, pedestals, capitals,* &c. *all from the proportions observ'd by Nature in the feet, leggs and thighs of man; pursuing the same Analogie, upon all occasions, throughout his whole work: and after to* Albert Durers *excellent Book* de Symmetria corporis humani. *To these may be added* Spigelius, *who in his first Book of Anatomy, from the* seventh Chapter *to the end of the Book, hath with singular diligence describ'd the proportions of the exterior parts.*

*For* Painting, *I recommend to them the incomparable* Lionardo Da Vinci, della Pittura: *not only because he was eminently skill'd in all parts of Anatomy, as appears by the accurate Figures that illustrate and adorn* Vesalius's *noble Volume* De Corporis humani fabrica, *all which were drawn and cut by* Da Vinci's *own hands; and the original*

*Draughts*

*Draughts of which are yet extant in a large Manuſcript of his in Folio, in the* Italian *language (but written from the right hand to the left) carefully preſerv'd in His Majeſties Cabinet at* White-Hall, *where I have had the good fortune ſometimes to contemplate them: but alſo becauſe in his Treatiſe* Della Pittura *juſt now mention'd, he ſeems to me to have deſcrib'd the figures, motions, forces and ſymmetry of the limbs, their Articulations and Muſcles, in various poſtures, more clearly than any other Writer I have hitherto read.* ¶.

*Having thus compendiouſly enquir'd into the Antiquity, and recounted ſome of the principal Uſes of Anatomy; 'tis now opportune for us to explain,* what notion *we have, and what are the moſt remarkable* DIFFERENCES *of the ſame.*

*Be it known therefore, that by* Anatomy, *according to the ſtrict uſe and proper ſignification of the Græc word* Ανατομὴ *or* Ανατομία, *I with all Learned Phyſicians and Chirurgeons underſtand, a* diligent, accurate and artificial diſſection of the body of any Animal, *chiefly of a* Man, in order to acquiring knowledge of the ſubſtance, magnitude, figure, ſite, ſtructure, connexion, action and uſe of all and every part thereof.

*In the true notion of Anatomy then, two acts are comprehended; a work of the hands,* Diſſection; *and an exerciſe of the Mind or Intellect,* Speculation. *Of theſe, the firſt is call'd by* Galen, Ανατομικὴ ἐγχείρησις, Adminiſtratio anatomica, *manual operation: the other,* Ανατομικὴ θεωρία, *mental contemplation.*

*And hence ariſes the firſt* Difference *of Anatomy,* viz. *the diſcrimination of it* in πρακτικὴν καὶ θεωρητικὴν, *into* Practic *and* Theoretic. *The* former *of theſe is to be acquir'd by long uſe and experience, and natural dexterity: the* later, *by reaſon and ſagacity, by hearing the Lectures, read-*

*ing the Writings of Learned men concerning that ſubject, and by intent Meditation. Again, the* former *may (for diſtinction ſake) be named* Hiſtorical; *the* later, ἐπιστημονικὴ, Scientific.

*To* Anatomic Adminiſtration *are requir'd, not only many* inſtruments *of various kinds, too well known to be here ſingly named, much leſs deſcribed: but various manual* Operations *alſo, beſides meer diſſection, all ſubordinate thereto:* viz. *exact* commenſurations *and* ponderations *of parts inquir'd into,* injections *of divers liquors by ſyringes,* inflations, extenſions, ligations, excarnation, *application of* Microſcopes, *and many others: and all to one general* End, *the attaining to perfect knowledge of the ſubject, and every the moſt minute part thereof; at leaſt as much Knowledge, as the narrow limits of Human Wit can comprehend.*

*To the* Theorical *or Speculative part it is requiſite that the Anatomiſt accurately obſerve* (1.) *the Univerſal* Structure *of the* whole, *and all its proportions, beauties, and general defects; alſo its general* Communities *and* Differences *with other Animals, and above all with other individuals of the ſame ſpecies:* (2.) *the* Conformation *and* Texture *of every part, with their Similar particles or viſible Elements; alſo the* Symmetrie *or proportion the parts hold both among themſelves, and compared with the whole; the* Communities *and* Differences *of one and the ſame parts in various Animals, and in other individuals of the ſame kind; the* compariſon *and* diſparity *of any one part with the reſt of the ſame individual; and finally the various* Sympathies *and* Antipathies *of every ſingle organical part:* (3.) *the various* Faculties, Actions *and* Uſes *of every part.*

*Of both, the moſt proper SUBJECT is the* body of Man extinct, *conſider'd as an Univerſal Organ adæquately accommodate to all Faculties of the Soul, and compos'd of a great*

*great multitude of leſs Organs, the retexture or unweaving of which, ſo as to find out the Mechanical reaſon of their motions and actions, is the grand ſcope of the Anatomiſt.*

*I ſay, the* moſt proper *Subject; not to exclude the bodies of* Brute Animals, *the diſſection of which alſo, though leſs properly, belongs to the Art of Anatomy, as being ſubſervient to the principal End thereof, nor a little helping to the more facil inveſtigation of what is ſought for in the moſt proper ſubject. For which reaſon,* Zootomie *or the diſſection of Brutes of various kinds, hath been commended and diligently practis'd by many as well Antient as Modern Phyſicians, as a thing of good uſe toward the advancement of the Hiſtory of Nature. Nor is* Dendranatomia *or the Anatomy of Plants and Trees, begun (as it ſeems) many hundred years paſt by* Theophraſtus, *and very lately with happy ſucceſs cultivated by* Malpighius *and our Dr.* Grew, *to be neglected: foraſmuch as from thence may be learned the admirable* Analogy *betwixt Plants and Animals, chiefly as to their Generation, Nutrition and Augmentation; and how far that Reſemblance holds.*

*I ſay alſo, the body of Man* extinct; *to intimate my juſt abhorrence and deteſtation of diſſecting Men* alive: *a cruelty condemn'd by* Celſus, *forbidden even by Humanity it ſelf, nor ever (for ought I have hitherto read) publickly permitted by any Nation how barbarous and ſanguinary ſoever, no not in the moſt flagitious of Criminals. I am not ignorant, either that* Herophilus *hath been by ſome* * *accuſed of inhumanly raking in the bowels of condemn'd Malefactors, while they lay roaring under his knife: or that* Fabius Quintilianus, *that excellent Orator, in his* eighth Declamation, *intitled* Gemini Languentes, *introduces the Wife impeaching the Husband* Malæ Tractationis, *for that he had given leave to an* Empiric (*for I cannot vouchſafe him a better title, nor eaſily find a worſe*) *to diſſect one of her Twinns while yet alive, that he might find*

* *Tertullianus* ait, *Herophilum* pluſquam ſeptuaginta cadavera ſecuiſſe, & ſæpe viva hominum corpora. & *Galenus* de eodem ſcribens, *Herophilus* (inquit) ad exquiſitiſſimam anatomes cognitionem pervenit, ac majori ex parte, non in brutis, ut plerique ſolent; ſed in Hominibus ipſis periculum fecit.

*find out the way to preserve the other, who languish'd of the same sickness: and yet notwithstanding I think my self free to choose whether I will believe or doubt the verity of these Accusations. For, the Works of* Herophilus *being lost, and nothing of his Memoirs remaining, but what hath been transmitted to us by such as either impugned his doctrine, or æmulated his glory: 'tis not improbable, but his frequent dissections of Living Beasts might give occasion to his Adversaries to feign him guilty of greater cruelty upon Men, by cutting up them also while alive. And as for* Quintilian's *Twinns; I should tell you no news perhaps, if I affirm'd, that the Roman Orators sometimes feign'd the subjects or arguments of their Declamations, supposing knotty and perplex cases, on purpose to shew the dexterity of their Wit, and power of their Rhetoric in unravelling them: and that therefore I think this case of the* Twinns *to be not really true, but only imagined by* Quintilian, *as a fit subject whereon he might make an elegant Harangue or pleading. But were it granted that these are no fictions; yet would it still remain to be prov'd, that the Dissection of Men alive, hath at any time been used with public permission or connivence among either* Græcians *or* Romans.

*The parts of a body dissected, whether it be of Man or Brute, are consider'd either* Absolutè, *as they appear in that body; or* Relativè, *as they have more or less of Analogie to the same parts in other Animals either of the same, or of a divers kind. And hence arises a second division of Anatomy into* Simple *and* Comparative: *of which the* former *is wholly conversant about the observation and knowledge of those parts, which pertain in general to the Body of Man, without farther Scrutiny: the* later, *tho' inservient to the former, is yet of much greater extent. For, to* Comparative Anatomy *it belongs* (1.) *to compare the* whole *body with all its most remarkable* parts; *and to note the weight, measure, proportion, symmetrie and pulchri-*

*tude*

*tude of both that and each of these:* (2.) *to compare the same parts in human bodies of different* Ages, *different* Sexes, *different* Climats, Countreys, *&c. for these things may cause a visible disparity, and there is no doubt but that the figure and structure of the interior parts is very little inferior, for variety and lineaments, to the exterior; and that the* Hearts, Livers *and* Ventricles *are as different in Men, as either their foreheads, or noses, or ears:* (3.) *to compare the parts of Brutes of various kinds,* Quadrupeds, Fowls, Fishes, *yea even of* Insects *and* Worms, *with the same or like parts in Man; that so the* Communities *and* Proprieties *may be observ'd and register'd.* Nemo enim de partis alicujus usu sive officio rectè determinaverit, qui ejus in pluribus animalibus fabricam, situm, annexa vasa, aliáque accidentia non viderit, secúmque diligenter pensitaverit. *Harv. in præf. ad lib. de Generat. Animal.*

*This* COMPARATIVE *Anatomy, how recent soever as to the name, was yet most certainly held in great estimation, and much practis'd by the* Antients, *chiefly* Græcians. *For, well known it is, that* Democritus *of* Abdera *exercis'd himself assiduously in dissection of Brutes of various kinds,* ἐ μισέων θεῶ ἔργα *(as himself expresly declared to* Hippocrates *come to visit him)* χολῆς θ διζήμενος φύσιν ἠ θέσιν, *not from hatred of Gods works, but curiosity to find out the nature and seat of* Choler *and* Melancholy. *Nor is it less known, that* Aristotle *also spent some years in the same work, as is most evident from his elaborate Books* de generatione, de partibus, *and* de historia Animalium: *being to that end furnish'd with Living Creatures of all sorts, that whole* Asia *and* Græcia, *in Land or Seas, afforded, at the charges of his Royal Disciple,* Alexander *the* Great, *to the expense of no less than eight hundred Talents: and that this mighty Conqueror, in the heat of his Wars and pride of his Triumphs, gloried in his*

In Epistola Hippocratis ad Damagetum.

Plin. lib. 8. cap. 16.

Athenæus lib. 9. cap. 13.

*his great proficiency in the knowledge of the nature and fabric of the parts of various Animals, under so wise a Teacher; as if he had obtain'd by his Learning no less glorious victories over the secrets of Nature, than he had gotten from Nations by his sword. How much* Galen *was vers'd in this* Comparative Anatomy, *is sufficiently apparent, not only from his excellent Volums* de Administrationibus Anatomicis, & de usu partium, *and the accompt he gives of his many public dissections at* Rome *in the presence of the Noblest Romans, and among them of* Boetius *and* Paulus Sergius *Consuls; but also from this, that some of the* Neoterics, *and principally* Vesalius, *objected against him, that he had been less conversant in the dissection of Human bodies. What progress the* Græc Physicians *that succeeded long after* Galen, *made in the same part of Anatomy, is indeed difficult to be collected from their Works, now grown almost obsolete among us: but whoever hath perused the monuments of* Aretæus, Theophilus, *and* Oribasius, *needs not to be advertis'd by me, that they have not wholly neglected it. If we come down to this last Century of years, we find the dissection of Brutes, in order to the collation of their inwards with those of Man, to have been diligently persued, first by* Falopius, Casserius Placentinus, *and* Bauhinus; *and after them, by* Fabricius ab Aquapendante, M. Aurelius Severinus, *and our immortal* Harvey, *&c.*

*Just cause therefore I have to admire, why the Lord Chancellor* Bacon, *a man of almost infinite reading, strong memory, and profound judgement, and who doubtless had look'd into the Writings of many, if not of all the Eminent* Authors *by me now mention'd; should yet notwithstanding* (in lib. de Augmento Scientiarum 4. cap. 2.) *among the* Desiderata Medicinæ, *put down this* Comparative Anatomy, *and so positively define it to be* deficient; *accusing* Physicians *to have altogether neglected it. Nor can I easily solve this my admiration, unless by conceiving, either*

(*that*

*that this Great Man understood much more of his own Profession, the Law, than of ours, the Art of Medicine; or that by the word,* Deficient, *he meant* Imperfect. *If this later Solution be admitted; then indeed he will be the less culpable: because it is too true, that the ample field of* Anatomy Comparative *hath not been hitherto so fully cultivated, as to bring forth a harvest rich and abundant enough to satisfie our hopes and expectation. But that Physicians have been guilty of so much sloth and ignorance, as to suffer it to lye barren and wholly neglected, through so long a series of Ages: this, I humbly conceive, ought not to have been affirm'd, unless it could have been fully prov'd.* ¶.

*Nevertheless I gratefully acknowledge, and applaud the Heroic Zeal this Illustrious Lord had for the improvement of our Art, among others useful to human life: yea I interpret his censure, not as a reproche, but* incitement *of our industry. And this I the more willingly do, because if he were somewhat too severe in his sentence of* Comparative *Anatomy, he hath bin (in the very same place of his Book) as much too favorable to* Simple; *concluding it to have been* most clearly handled, and observed even to a curiosity: *whereas in truth we are not so happy, as to have just cause to say so at this day. For, after all the new* Discoveries *made in Human bodies by Anatomists who have liv'd since his time,* Simple *Anatomy must be confess'd to be still in its Youth, far short of Maturity and Perfection. There are yet, alas!* terræ incognitæ *in the Lesser World, as well as in the Greater, the Island of the* Brain, *the Isthmus of the* Spleen, *the Streights of the* Renes Succenturiati *and some other* Glandules, *the North-east passage of the drink from the Stomach to the* * *Kidnies, and many other things, remain to be farther inquir'd into by us, and perhaps by Posterity also. In fine, this* Simple

* Serosi humoris iter ad renes, hactenus quæsitum magis, quàm repertum arbitror: frustráque fuisse omnes, qui *Isthmum* hunc fodere aggressi sunt, &c. *Cl. Entius in Antidiatribe pag.* 13

# PREFACE.

Anatomy *is a ſtudy ſo abſtruſe and difficult, and withal ſo vaſt and diffuſe; that the laſt complement of it cannot with reaſon be expected from the diligence of any one Man how ſagacious and induſtrious ſoever. 'Tis therefore ſeriouſly to be wiſh'd, that the work were ſo divided among thoſe curious Wits, that are by ſecret inſtinct diſpoſed to digg in this mine of knowledge, as that every one might take to his ſhare ſome one ſingle part of thoſe that are not yet fully explain'd, and do his beſt devoirs to explore and demonſtrate the whole* Mechanic *frame of it. If this were done, doubtleſs we ſhould in few years find a very conſiderable Acceſſion made to the late inventions in Mans body, and with more juſtice than now we can, approve the* Lord Verulam's *opinion, that Simple Anatomy is alredy arriv'd at Perfection.*

*To advance this ſo noble, ſo uſeful Art of* Anatomy, *and accelerate its progreſs toward Conſummation; that ſo the* Pathologic *part of Medicine being by degrees rais'd from the darkneſs of uncertain Conjectures, to the light of even ſenſible Demonſtrations, the infirmities of Mens bodies may at length be more certainly and eaſily cured, their pains and torments ſooner eas'd, and their Lives prolong'd: to this Noble End, I ſay, this Magnificent THEATRE, wherein we now ſit, hath been with ſo great coſt and art erected by the* Generoſe *FOUNDERS; whoſe private Munificence, exceeding that of Kings, admits of no rival but the* Wiſdom *that directed it; whoſe large hearts were at the ſame time fill'd, with* Charity *toward all Mankind of the preſent Age, and with* Providence *for the relief of all in Ages to come.*

*Among theſe,* Gratitude *it ſelf exacts, that I ſhould with ſingular honor mention our* Principal Benefactor, *Sr.* JOHN CUTLER; *a Perſon to whom God hath given that double bleſſing of great* Riches, *and as great* Prudence *how to uſe them to the nobleſt of Human Ends,*

*Ends, the* Public Good; *and who having no* Augustus *to favor and assist his Beneficence, is by so much a greater Patron to Learning than* Mecænas *was.*

*Doth any here think, that this stream of His Bounty might have been deriv'd upon some other ground more fruitful of benefits, than this* Garden of Philosophy? *Let me, to undeceive that man, advise him seriously to consider, first that excellent sentence of* Pythagoras (*to whom all Philosophers ow that modest name*) *that there are two things which most ennoble Man, and raise him up to a resemblance of the Divine Nature, namely,* to know truth, *and* to do good: *and then, that there is no* Human Science *that doth either more gratifie and enrich the* Understanding *with variety of choice and useful truths; or more enable a* Generose Mind *to exercise its* Faculties *to the good and benefit of others, than that of* Anatomy, *as it is a principal fundament of* Medicine, *doth. For, both these are certain and evident Verities: and after due consideration of them, no man can longer doubt, that he who placeth his Munificence upon erecting an* Anatomic Theatre, *for advancement of the Art of Healing the Sick; doth a Work as conducive both to the* Glory *of* God, *and to the* Common Good *of* Mankind; *as he that builds a* Church, *or as he that founds and endows an* Hospital.

*I say, to the* Glory of God; *because I am taught, not only by* Galen (3. de usu partium.) *that the discerning ones self, and discovering to others the Perfections of God displaid in His Creatures, is a more acceptable act of Religion, than the burning of Sacrifices or perfumes upon His Altars; nor only by* Trismegistus (in Asclepium cap. 15.) *that the thanks and praises of Men are the most grateful incense that can be offer'd up to God: but even by* God *Himself, in His Written Word, that* he who sacrificeth Praise (*for so 'tis in the Original*) honors Him.

*I say also*, to the common Good of Mankind; *as well because the* Necessity *of Medicine is* Universal; *so that even* Kings *themselves are sometimes forced to obey the precepts of Physicians, when the pains they feel assure them, that a* Crown *cannot mitigate the* Head-ake, *nor an* Army *deliver from the horrors of a* Fever, *nor the Roial* Garter *drive away the torments of the* Gout: *as because* to heal the sick, *is by so much a nobler act of Charity, than to feed the Hungry, or cloth the Naked, by how much* Intellectual Powers *of the Mind are both more* difficult *to be attain'd, and more* Excellent *in their nature, than the transitory gifts of* Fortune. *Riches many times come easily, and unexpected, even to Men ignorant of the right use of them: the* Art of Healing *is never acquir'd but by hard, anxious, and long study, and by accurate Observations. Manifest therefore it is, that whosoever by his Munificence contributes to the advancement of this so difficult, so noble, so universally useful Art, doth thereby signalize both his* Piety *toward* God, *and his* Charity *toward* Men, *in a way most acceptable to* Him, *most beneficial to* them.

*More, much more I would say in Commemoration of this Worthy* Knight's *Exemplary* Bounty; *but that I know, that to him it is far more grateful to conferr* Benefits, *than to receive* Acknowledgments; *and that this very Fabriok hath alredy rais'd him, as above all* Envy, *so above all* Praises. *The same will (I propheſie) remain a perpetual* Moniment *of his Heroic Zeal for the promotion of* Natural Science, *and recommend his* Name *to all posterity. For,* Fame *built upon Universal Beneficence, cannot but be* immortal; *because it can be no mans interest to suppress it, and all are by gratitude obliged to propagate it. Some* Great *Men (as the Vulgar call them) hunt after Renown, by enlarging Empires and Kingdoms; some by conducting mighty Armies, and fighting bloudy Battles; others again by erecting Pyramids, massy Tombs, and other the like Pa-*

*geants.*

geants of human injuſtice, pride, or cruelty: but theſe, alas! all theſe perſue only flying ſhadows: and either the gulph of Oblivion will ſoon ſwallow them down, as ignoble and obſcure; or if any memory of them chance to ſurvive their funerals, 'twill be conjoin'd with contempt and deteſtation. Quæ ſaxo cruuntur (ſaith Tacitus, Annal. lib. 4.) ſi judicium poſterorum in odium vertit, pro ſepulchris ſpernuntur. Only thoſe happy Men ſhall floriſh in the eſteem and veneration of all future Generations, who have acquir'd fame and honor by doing good. This therefore is true Glory, and of this our Noble Benefactor, of whom I ſpeak, may reſt ſecure. Multos veterum velut inglorios & ignobiles oblivio obruet: CUTLERUS poſteritati narratus & traditus, æternum ſuperſtes erit. ¶.

Would I were equally ſecure of Your good acceptance (I dare not ſay, Approbation) of the mite I am about to contribute toward the accompliſhment of his ſo glorioſe Deſign. But, alas! this is a wiſh without hope; ſo deſtitute I know my ſelf to be of all the Faculties of Mind requiſite to ſo difficult an Atchievement; my Zeal for the promotion of Anatomy, only excepted: and much more reaſon there is, why I ſhould apologize for my inſufficiency, before I farther expoſe it. Notwithſtanding this diſcouragement, conſidering with my ſelf, that profound Erudition, and great Humanity are (like Love and Compaſſion) inſeparable: I think it much ſafer to confide in Your Candor and Benignity for pardon of my Defects, than to attempt to palliate them, by Excuſes, however juſt and evident. Not to be conſcious of my faileurs and lapſes in my following Lectures, would argue me of invincible ignorance; not freely to acknowledge them, would be tacitly to defend them: to ſeek by ſpecioſe prætences of haſt, of frequent diverſions, of natural impatience of long meditation,

*ditation, of bodily indiſpoſitions intervenient, and other the like vulgarly alleged impediments, to* extenuate *them; were the moſt certain way to* aggravate *them: and to* conceal *them from your ſight, is in this place and occaſion impoſſible. Having then no other Refuge but in Your* Grace *and* Favor, *I fly to that alone, to ſecure me from the danger of malignant Cenſures, which I am more than likely to incurr: nor will I fore-arm my ſelf with any other defenſe, but this.*

*If the* Matters *of my ſubſequent diſcourſes ſhall appear to be, neither Select, nor of importance enough to compenſate Your time and patience; be pleas'd to remember that ſaying of* Ariſtotle, (Metaphyſ. lib. 2. cap. 1.) Non ſolùm illis agendæ ſunt gratiæ, quorum opinionibus quis acquieſcet; ſed iis etiam, qui ſuperficie tenus dixerunt. Conferunt enim aliquid etiam iſti: habitum namque noſtrum exercuerunt. Si enim *Timotheus* non fuiſſet, multum melodiæ nequaquam habuiſſemus. Si tamen *Phrynis* non fuiſſet, nè Timotheus quidem extitiſſet, *&c.*

*If my* Stile *ſhall ſound ſomewhat harſh and ungrateful many times to Ears unaccuſtomed to any but their Mother tongue, as coming too near to the Latin; I intreat you to conſider, this is either no indecency in this place, or ſuch a one at worſt, which I could not otherwiſe avoid, than by involving my ſenſe in the obſcurity of words leſs proper and ſignificant; the nature and quality of the Subjects treated of, being ſuch, as cannot be fully expreſſed in our yet imperfect Language. So that I have a clear right to that honeſt plea of* Lucretius,

Abſtrahit invitum patrii ſermonis egeſtas. ¶.

PRÆLECTIO

# PRÆLECTIO I.

# Of Nutrition.

MAN being consider'd, *ut Animal Rationale*, as a *living* Creature naturally endow'd with *Reason*, and compos'd of two principal parts, a *Soul* and a *Body*; each of which hath various *Faculties* or *Powers*: the summe of *Human Nature* must be comprehended in those *Powers* conjoyn'd.

Of these Powers, some are peculiar to the *Soul* or *Mind*, others belong to the *Body*, as Organical and animated by the Soul.

To the *Former* sort are referr'd the Faculties of *thinking*, *knowing*, *judging*, *reasoning* or *inferring*, *concluding*, *electing*, and *willing*; all commonly signified by *Understanding* and *Will*. All which being remote from the Province of *Anatomists*, I leave them to be handled by *Philosophers* inquiring into the nature of the Soul.

Of the *Later*, some are requisite to the complement of Man, as single or *individual*; *viz.* the Faculties of *Nutrition*, of *Life*, of *Sense*, and of *Voluntary Motion*: and there

there is one that respects the Procreation of Mankind, namely the Power *Generative*. And these are the natural Faculties, to which as principal Heads, the Learned Anatomist is to referr all his Disquisitions; that at length he may (if it be possible) attain to more certain knowledge of the Mechanic frame of the Organs in which they are founded. But being more than can be, tho' but perfunctorily, enquir'd into in so few hours as are assign'd to this publick Exercise; I have therefore chosen to treat of only some of them at this time, *viz.* *Nutrition*, *Life*, and voluntary *Motion*; not as more worthy to be explain'd than the rest, but as more comprehensive or of larger extent.

I have chose also to begin from *NUTRITION*; not only because the Stomach, Gutts and other parts principally infervient thereto, being, by reason of impurities contain'd in them, more prone to putrefaction, ought therefore first to be taken out of the cavity of the *Abdomen*, to prevent noisomness: but because *Nutrition* seems to be, if not one and the same thing with, yet at least equal or contemporany to *Generation* it self; and that both κατὰ χρόνον, in respect of *Time*; and κατὰ φύσιν, in respect of *Nature*.

For tho' the operation of the Power *Generative*, or *Formative* Virtue, may seem to precede that of the *Nutritive*: yet in truth the *Stamina* or first rudiments of an Embryo are scarcely delineated, when they begin to be augmented also by nutrition; so that 'tis consentaneous as well to the observions of Dr. *Harvey* and others since, as to reason, that Formation and Nutrition are but different names of one and the same act of the *Plastic* power. Again, *Generation* and *Accretion* are not perform'd without *Nutrition*: nor *Nutrition* or *Augmentation* without *Generation*. To *nourish*, what is it but to substitute such, and so much of matter, as

is,

is, by reaſon of exhauſtion, wanting to the ſolid parts of the body, namely fleſh, nerves, veins, arteries, *&c.* ? and what is that in reality, but to *generate* fleſh, nerves, veins, arteries, *&c.* ? In like manner *Accretion* is not effected without Generation; for all natural bodies capable of Nutrition, are by acceſſion of new parts augmented, and theſe new parts muſt be ſuch as thoſe of which the bodies were at firſt compoſed: and this is done according to all their dimenſions. So that in verity, the parts of an Animal are increas'd, diſtinguiſh'd, and organiz'd all at the ſame time, by the ſame *Formative* power. Moreover if we reflect upon the *Efficient* cauſe of Formation and Nutrition, and upon the *Matter* it uſes; we ſhall on both ſides find it neceſſary, that thoſe two works (if ye will have them to be diſtinct) be carried on together. On the part of the *Efficient*; becauſe *idem eſſe principium efficiens, nutriens, & conſervans in ſingulis Animalibus, neceſſe eſt: niſi aliam formam in puero, aliam in adoleſcente, & in ſene aliam conſtituamus; quod abſurdum eſt.* On the part of the *Matter ex qua*; becauſe all Animals (ſuch as are produced *per Epigeneſin*, of which alone is our diſcourſe: not of ſuch *Inſects* that are generated *per Metamorphôſin*) are made of one part of the Matter prepar'd by the Formative Spirit, and nouriſh'd and augmented out of the remainder, not out of a divers matter. For, whatſoever is ſuperadded to the firſt rudiments of the parts, ought certainly to be of the very ſame ſubſtance with what was præexiſtent, and ſo muſt conſiſt *ex congenere materia*: their renovation, as well as firſt corporation, being effected by Aggeneration or ſuperſtruction, *i. e. per Epigeneſin.* So that from all theſe reaſons put together it is conſtant, that Nutrition is nothing elſe but *Generation continued*; and as neceſſary to the conſervation of every individual Animal, yea every individual Plant

also, as Generation it self is, to the conservation of the Universe. Which our most sagacious Sr. G. *Ent* well understanding, recommends to the belief of his Readers in these few, but memorable words (in Antidiatribæ pag. 40.) *Nutritio sane videtur esse veluti continuata quædam generatio; quæ est opus* ideale, *ad exemplar primitivum actiones suas dirigens*, &c.

That I may both illustrate and confirm this Theorem, give me leave to represent to you in a few lines, the method and process of Nature in the formation of a Chick out of an Egg according to the most accurate Observations of *Malpighius*, the summe of which is this. From those Observations, containing eight several acts of the Formative power, it is highly probable,

*In lib. de ovo incubato.*

(1.) That the *Spirit*, *Plastic Virtue*, or *Archeus* (call it by what name you please) of the Egg, lies dormant as it were and unactive for some time after the Egg hath been laied, as if it expected the incubation of the Hen, or some other warmth equivalent thereto, to help it to exsert its power, and begin the great work of building for it self a house, according to the idea or modell prescrib'd by the Divine Architect, whose instrument it is: and that having obtain'd that requisite aid, it soon acts upon the *genital humor*, in which it is lodged, by way of attenuation or eliquation, that so the *Matter* may be made more fluid and obedient to its energy. Which seems to be the *first* Act.

(2.) That this *Spirit*, having drawn the first lines or threds of the solid parts of the *Embryo*, and dispos'd them into their proper seats, doth immediately after design certain wayes or passages, by which those slender and delicate *Stamina* may be commodiously supplied with *vital* and *nutritive* liquors, for their enlivening and nutrition: and to that end, mark out and appoint three Fountains as it were in the now more fluid

*Colliquamentum*,

*Colliquamentum*, and thence deduce as many *Canales* or rivulets; two of which are from their origine united, and therefore somewhat greater; one out of the first rudiments of each ventricle of the *Heart* (not yet conspicuous, because not coagulate, but pellucid) and a third consisting of many smaller rills flowing from the like rudiments of the *Brain*. So that we may thence collect, that the two former of these Canales are made to bring in the vital humor from the Heart, the third to bring in the *Succus Nutritius* from the Brain, to the first rudiments of the Chick: and that in process of time, these are turn'd into the *Aorta* and *arteria Pulmonaris*; these into pairs of *Nerves*. And this I take to be the whole work of the *second* Act.

(3.) Lest these so necessary fountains should by exhaustion fail, the same Architect, directed by divine instinct, provides also for their perpetual supply. To irrigate the *Brain*, Rivulets are brought thither from the trunc of the grand canale of the Heart: and to feed the current of the *Heart*, three new streams are deriv'd to it; *one* from the *interior* Lake or *Colliquamentum*, a *second* from the *exterior* by the wayes of the Navill, and a *third* from the yolk of the Egg by veins, that by all these importing conduit-pipes fresh liquors may be continually deduced from the parts nourished into the Heart. Which pipes are soon after compacted into *veins*, either such as are design'd to bring back the *Bloud*, or such as are ordain'd to convey the *Chyle*, or the *Lympha*. And this may be call'd the *third* Act.

(4.) 'Tis evident, that the same invisible Agent advances in the next place to distribute the vessels derived from the rudiments of the Heart, *viz.* the *Arteria Pulmonaris* and *Aorta*, first whole, then divided and subdivided into branches still smaller and smaller, till at last they dwindle into *Capillaries*: and on the contrary,

to collect and by degrees unite all the rivulets that return from the *Stamina* of the solid parts to the Heart, till they all meet and make a confluens in the single trunc of either the *vena portæ*, or *vena cava*. For even common sense teaches us to call that the original or sourse of a Canale, from whence the liquor which it conveys, flows: as every River is truely said to begin from its head or spring. And *Malpighius* hath, by the help of Microscopes, observ'd, and in his sixteenth and eighteenth Figures faithfully (as I believe) represented, certain varicose veins lying in the Umbilical *area* or space, not yet extended to either the Heart or Liver: and therefore also, not the Heart, but the *Stamina* of the parts circumjacent, ought to be reputed the Origin of the veins. And this *distribution* of one sort of Canales, and *collection* of another, completes the *fourth* Act.

(5.) No less evident it is, that from the beginning the *Vital Nectar* is clear and transparent, and so remains, till somewhat of the *Yolk* hath been mix'd with it. For, not only *Malpighius*, but our equally curiose Dr. *Glisson* (*de ventriculo & intestinis cap.* 20. *num.* 67.) expressly affirms, that he had seen bloud of a rusty colour in the coats involving the Embryo of a Chick, before any the least signe of bloud could be discern'd in or about the Heart. But this so early beginning of bloud may be ascrib'd, either to the speedy excitation of the Spirits by the incubation of the Hen, to whose heat those veins are somewhat nearer than the Heart is: or to this, that perhaps somewhat of a yolky tincture had preceded and caus'd that rusty or dark red. However, this beginning of Change in the Vital liquor from transparency to redness, seems to be the *fifth* Act.

(6.) All the Canales just now describ'd, being fix'd and open'd, and the vital liquor exalted some degrees nearer

nearer to perfection; the *Plastic Spirit* proceeds to finish the whole body: so regulating its operations, as to augment those parts first, which ought to be first used; and then to add to the dimensions of others, whose use may be longer wanted without detriment. And this slower work of accomplishing all parts, by way of *Nutrition* and *Augmentation*, may be accounted the *sixth* Act.

(7.) The same *Architectonic Spirit* as it spinns the first *Stamina* of all the solid parts, so doth it gradually augment and complete them all out of one and the same homogeneous liquor, *viz.* the *Colliquamentum*, or spermatic humor clarified by Eliquation: and this by *transmuting* the same into as many several forms, as there are different kinds of similar Spermatic parts in the whole body; namely into *bones*, *cartilages*, *ligaments*, *tendons*, *membranes*, *fibres*, &c. So that all the Organs are at length compos'd of dissimilar parts by wonderful artifice context, without the least of confusion or incongruity. Which deserves to be reckon'd the *seventh* Act.

(8.) In that work of *Organization*, 'tis credible, the inimitable Artist *divides* without section, only by terminating the parts; and *unites* without glew or cement, only by continuing them to the common term or bounds, which depends more upon union of matter, than upon union of nature. By these admirable artifices of Division and Unition, the *Plastic Spirit* perforates, separates, conjoins, cements the yet fluid, at least soft *Stamina* of the parts, where, how, and as often as need requires: it deduces and runns out their Rivulets terminated in the fluid matter as by chanels; it preserves from confusion the two different *Colliquamenta*, and the *Yolk*, divided as it were by partitions: it so distinguishes and disterminates even contiguous and semblable parts,

that

that they may be diverſly moved at the ſame time without interfering or impediment, and each yield to other when occaſion requires: and thus almoſt all fibres, very many membranes, and (in many ſorts of Animals) the Lobes of the Lungs and Liver, and the Cartilages mutually touching each other in the joints, *&c.* are divided among themſelves. In a word, by theſe wayes and degrees here by me from *Malpighius* his Microſcopical Obſervations collected and rudely deſcribed, it ſeems moſt probable, that the *Embryo* is form'd, augmented and finiſh'd in an Egg.

Now therefore (that we may accommodate this *Epitome* to our preſent Argument) if this be the method and proceſs that Nature uſes in the Generation of *Oviparous* Animals; and if ſhe uſes the like in the production of *Viviparous* alſo, as Dr. *Harvies* obſervations, and our own aſſure us that ſhe doth: we may ſafely conclude, that Human *Embryons* are in like manner form'd, augmented and finiſh'd, by one and the ſame Plaſtic Spirit, out of one and the ſame matter, the *Colliquamentum*. *Quod erat probandum.*

I add, that the ſame *Plaſtic Spirit* remaining and working within us through the whole courſe of our life, from our very firſt formation to our death; doth in the ſame manner perpetually regenerate us, out of a liquor analogous to the white of an Egg, by tranſmuting the ſame into the ſubſtance of the ſolid parts of our body. For, as I ſaid before, *Nutrition* is neceſſary to all Animals, not only in reſpect of the *Augmentation* of their parts, while they are little *Embryons*; but alſo in reſpect of their *Conſervation* after during life: becauſe their bodies being in a natural conſumption or exhauſtion, would inevitably be ſoon reſolv'd into their firſt elements, unleſs the providence of Nature had ordain'd a continual renovation or reparation of the parts,

by

by ſubſtitution and aſſimilation of freſh matter, in the room of thoſe particles diſpers'd and conſum'd. Having therefore, to ſome degree of probability explain'd the former neceſſity of Nutrition, and the cauſes of it, my next buſineſs muſt be, to inquire into the *Later*. Which that I may the more effectually do, I find my ſelf obliged to begin my ſcrutiny from the *Cauſes* of the perpetual *Decay* or *Depredation* of the ſubſtance of our bodies, *viz.* the *Efficient* or *Depræ dator*, and the *Matter* or ſubſtance thereby conſum'd, and the *Manner* how.

The *Depræ dator* then, or *Efficient* cauſe of the perpetual conſumtion of our bodies, ſeems to be, what all Philoſophers unanimouſly hold it to be, the *Vital Heat* of the bloud, therein firſt kindled by the Plaſtic Spirit, continually renew'd by the Vital Spirit, and by the arteries diffus'd to all parts of the body, that they may thereby be warm'd, cheriſh'd, and enliven'd. This *Lar familiaris*, or *Vital Heat* continually glowing within us, and principally in the Ventricles of the Heart, call'd by *Hippocrates*, ἔμφυτον πῦρ, *ingenitus ignis*; by *Ariſtotle*, ἡ ἐν τῇ καρδίᾳ τῆς ψυχῆς ἐμπύρωσις, *accenſio animæ in corde*; and *flamma Biolychnii*, the flame of the Lamp of Life, by others; and by others again, *ignea pars Animæ Senſitivæ*: is what Phyſicians generally have heretofore underſtood by *Calidum innatum*, tho' they ſeem to have had but an obſcure and inadæquate notion of the thing it ſelf, as I hope to evince, when I ſhall come to inquire, what *life* is, and upon what it chiefly depends. Meanwhile ſuppoſing it to be an *Actual Heat* conſiſting in a certain motion of the various particles of the bloud, and in ſome degree analogous to fire or flame; I cannot conceive, how 'tis poſſible for it to ſubſiſt or continue, for ſo much as one moment of time, unleſs it be maintain'd by convenient fewel, which is thereby unceſſantly fed upon, and by degrees conſum'd: for it is

of

of the nature of all fire, how gentle or mild ſoever, to generate and conſerve it ſelf only by preying upon and deſtroying the matter in which it is generated. This *Vital Heat* therefore without intermiſſion agitating, diſſolving and conſuming the minute and moſt eaſily exſoluble particles of the body; muſt be the *Deprædator* here ſought after. So that in truth, we have one and the ſame cauſe both of our *life*, and of our *death*; or (to ſpeak more properly) our very life is nothing but a continual death, and we live becauſe we die. For, we live ſo long, as while this internal Veſtal Heat is kept glowing in the bloud: and when it ceaſes to glow, either from want of convenient ſuſtenance, or by violent ſuffocation, life is inſtantly extinguiſh'd. So true even in this natural ſenſe is that Diſtich of *Euripides*;

*Quis novit autem, an vivere hoc ſit emori:*
*An emori, hoc ſit quod vocamus vivere?*

The *Matter* conſum'd, I humbly conceive to be, for the greateſt part, the *fluid* parts of the body, chiefly the *bloud* and *ſpirits*, which are moſt eaſily exſoluble; and ſomewhat, tho' but little, of the ſubſtance alſo of the *ſolid* parts. For, Experience teaches, that divers Animals, Bears, Dormice, Swallows, *&c.* ſleep the whole Winter, without receiving any ſupply of aliment: and yet have all the ſolid parts of their bodies as large and firm, when they awake again in the Spring, as when they firſt betook themſelves to their dens or dormitories: and the *Reaſon* hereof ſeems to be this, that their *Vital Heat* being all that time calm and gentle, conſumes their bloud and ſpirits but ſlowly, and very little of their ſolid parts; as a lamp burns long, when the oyl that feeds it, is much, and the flame but

but little and calm. We have Examples alſo of *Leucophlegmatic Virgins*, who from a gradual decay of Appetite, have fall'n at length into an abſolute averſion from all food, and endur'd long abſtinence, without either miracle or impoſture; and yet notwithſtanding have not been emaciated in proportion to the time of their faſting. Whence 'tis probable, that in our bodies there is not ſo rapid and profuſe an expenſe or exhauſtion of the ſubſtance of the ſolid parts, as heretofore many learn'd Phyſicians have imagin'd to be made by the activity of the Vital Heat.

If it be *objected*, that in many diſeaſes, the habit of the body is wont to be very much extenuated: we are provided of a double *anſwer*. *Firſt*, That extenuation ſeems to proceed rather from a meer ſubſidence or flaccidity of the Muſculous fleſh, for want of bloud and the nouriſhing juice to fill and plump it up; than from any great deperdition of the ſubſtance of the fibres, of which the Muſcles are moſtly made up: otherwiſe ſuch decayes could not be ſo ſoon repair'd, as we obſerve them to be in the ſtate of convaleſcence. *Secondly*, Whatever be the cauſe of the extenuation objected, it impugns not our preſent ſuppoſition, which extends not beyond the natural and ordinary depræ-dation made by the Vital Heat in the ſtate of *Health*.

And as for the *Manner* how the bloud, ſpirits, and other fluids (and if ye pleaſe to have it ſo, alſo the leſs fixt, and more eaſily exſoluble particles of the ſolid parts) are conſum'd by the Vital Heat; this may be ſufficiently explain'd by the familiar example of oyl conſum'd by the flame of a Lamp. Whether we take fire or flame to be a ſubſtance luminoſe and heating; or conceive it to be only a moſt violent motion of globular particles in its *focus*: moſt certain it is, that it conſiſteth in a perpetual *fieri*, *i.e.* in a continual agi-

tation or accenſion of the particles of its τροφιμον, *pabulum* or fewel, and periſhing as faſt as it is propagated: ſo that fire is made fire, and again ceaſeth to be fire, in every the ſhorteſt moment of time; and when in the combuſtible matter there remain no more particles, in which it may generate it ſelf anew, it inſtantly periſhes. Now continual *Diſperſion* being the proper and viſible effect of fire or flame; the matter or fewel wherein it ſubſiſteth, cannot but be in continual flux or decay. In like manner, the *Vital Heat* of Animals ſubſiſting by a continual accenſion of new ſpirits in the blood, as that is paſſing through the Heart; thoſe vital ſpirits, tranſmitted from thence through the arteries to the habit of the body, no ſooner arrive there, but having warm'd and enliven'd the ſolid parts, they immediately fly away, and diſperſe themſelves by inſenſible tranſpiration, carrying along with them many watery vapors, and (perhaps) ſome ſulphureous exhalations. Moreover, there being in all the ſolid parts of the body, certain mild, ſweet and balſamic ſpirits, as it were affixt unto and concorporated with them; 'tis very probable, that the Vital Spirits acting upon them alſo by way of exagitation, by little and little diſlodge them, render them Volatil, and at length wholly diſperſe them: whereupon the minute particles in which they did reſide, become mortified, and as excrements, are excluded together with the exhalations of the blood. And this I apprehend to be the reaſon and manner of the deprædation made upon the body by the Vital Heat.

Here no man will I hope, exact from me an accurate *computation* of the daily expenſes of this Vital Heat, which like ſome Governors, rules by exhauſting. If any ſhould, I might perhaps applaud his curioſity, but ſhould not be able to ſatisfie it. For, ſo great

great is the difference among men, in reſpect of temperament, diet, age, exerciſe, the ſeaſon of the year, and various other circumſtances, that no definite calculation can be made of this diſpenſe, no not in thoſe who keep to the ſtricteſt rules of an *Aſcetic* life, weighing themſelves and their meat and drink, as *Cornaro* is reported to have done, daily. We may indeed conjecture from the *Static* experiments of *Sanctorius*, that the expenſe is great; for inſtance, if forty pounds of meat and drink be ſuppos'd ſufficient to maintain a man of a middle ſtature, ſober, and of good health, for ten days; and about twenty pounds be aſſign'd to the excrements voided by ſtool and urine in that time: the other twenty pounds may be reaſonably aſcribed to inſenſible tranſpiration: but ſtill this is mere conjecture. Let it then ſuffice, that we certainly know the quantity of bloud and ſpirits daily exhauſted by the Vital Heat that conſerves life in us, is very great: and that the greateſt part of the matter of inſenſible tranſpirations, is the Vital Spirits, which are continually generated, and continually diſpers'd.

How apt and powerful theſe Vital Spirits are, by reaſon of their ſubtility and brisk motions, to exagitate and diſperſe the more exſoluble particles of even the nerves, fibres, membranes and other tender and ſenſile parts; may be in ſome meaſure collected from various *diſeaſes* and *ſymptoms*, that ſeem to ariſe from their various depravations or vicious qualities. I ſhall not therefore goe much out of my way, if I make a ſhort *Digreſſion*, to recount a few of thoſe painful and contumacious Maladies, which are with good reaſon referrible to the *vices* of the Spirits, rendring the tone of the nervous parts either more *ſtrict* or more *lax* than it ought to be; at leaſt according to the doctrine of *Proſper Alpinus*, not long ſince reviv'd and illuſtrated

lustrated by Dr. *Franc. Glisson*, whose name is Elogie sufficient.

If it happens, that the Blood is too *vinose*, *i.e.* too abundant in Spirits (as in Good-fellows commonly it is) many times it induceth diseases depending upon *Fluxion*. For being by the arteries protruded into the more tender parts with greater force and impetuosity than is fit, it rather invades than cherishes them, by that violence putting their unfixt particles into a flux. And this *Fluxion* usually first invades such parts, as being weaker than the rest, are therefore more dispos'd to receive it. If the prevailing Spirits of the bloud be, not only Vinose, but *Saline* also; many times there insues the like *Fluxion* conjoin'd with a languor and *laxity* of the tone of the parts, such as is alwayes observ'd in *Catarrhs*, in moist *Coughs*, in *Ebriety*, great heavinesse to sleep, the *running Gout*, *&c.* And 'tis remarkable, that these Fluxions are usually so much the more fierce and vexatious, by how much the more infirm and yielding the nerves and fibres of the part invaded are; because these want strength to make resistence by vigorous contraction of themselves: whereas nerves naturally strong and tense, somewhat repress and break the force of the bloud rushing in upon them. Which is perhaps one, if not the chief reason, why men of firm and vigorous nerves are very seldom or never infested by the *Gout*. If this *resolving* fluxion chance to be accompanied with a *Fermentation* of the bloud; then commonly the evil consequent is a rheumatic, arthritic, or pleuritic *Fevre*.

On the contrary, if the Spirits that have obtain'd dominion in the bloud, be *Sulphureous* or oyly; there follows a Fluxion causing a *Constriction* and shutting up of the invaded part. For tho' the arteries poure out bloud abounding in impetuous Spirits, and so

cause

cauſe a Fluxion: yet notwithſtanding thoſe Spirits, by reaſon of their oylineſs, neither eaſily paſs through the habit of the parts, as the *Saline* do, nor are diſpers'd by inſenſible tranſpiration; but remain ſhut up, as in a cloſe priſon, and ſtriving for liberty, raiſe great tumults and pains. Hence are excited various *Symptoms*, according to the various parts into which the Fluxion ruſheth: in particular, if the Fluxion be determin'd upon the *Gutts*, there follow grievous *Colic* pains; if in the *Stomach*, a dire *inflation* of it; if upon the *Limms*, that ſore affect which Phyſicians generally call a *Rheumatiſme*, which is not, as ſome have erroneouſly thought, rain'd down from the head, but proceeds only from ſulphureous Spirits effuſed out of the arteries into the habit of the body, and therein impriſon'd, their own oylineſs making them unapt to tranſpire; and their tumultuous diſtenſion of the parts conteining them, cauſing acute pains. Hence alſo come wandring *Scorbutic* pains, *Hypochondriac* winds, *rumblings* in the ſtomach and gutts, *Head-aches*, the *Tooth-ake*, *&c.* And all theſe evils are the more aggravated, by how much the more firm and tenſe the nerves of the part affected are: whereas in *Saline* fluxions the contrary happens, tho' they be no leſs pernicious in the end, by relaxing, fretting, and as it were melting the tone of the parts affected.

Finally, if the ſtrength of the nerves and fibres be greater than the force of the bloud flowing in from the arteries; in that caſe ſucceeds a Diſeaſe *è diametro* contrary to Fluxion; *viz.* *Obſtruction* and *Infarction*, and for the moſt part tranſpiration hinder'd. The manner how, ſeems to be this: The too rigid tenſion of the nerves and fibres in any part, rendring the paſſage of the arterial bloud through it more difficult than is requiſite to the circuition of it freely; the thicker and more viſcid parts thereof muſt

of

of neceſſity ſtick in their paſſage, and ſo produce *Obſtructions*. And this vice alwayes is the more intended, by how much the more languid and ſluggiſh the Vital Spirits are. For when theſe are copious and vigorous, they eaſily prevail over the light renitence or reluctance of the nerves, and maugre their oppoſition carry on the bloud in its circuit: but when they flagg and act but dully, they yield to the oppoſition of the nerves and fibres, and leave the groſſer and more viſcid parts of the bloud ſticking in the paſſages. In a *Cachexy*, *Dropſy*, *Aſthma*, *Scorbute*, obſtruction of the pipes of the Lungs, tumors and imflammations of the *viſcera*, *&c.* the nerves commonly are more ſtrict or tenſe than they ought to be. But if a *Saline* fluxion chance to be conjoyn'd with, or to ſupervene upon ſuch an exceſſive tenſion of the nerves, it either wholly ſolves the diſeaſe, or very much mitigates it at leaſt. Whereas on the contrary, if while the nerves and fibres continue ſtrong, ſuch a conſtriction of them be accompanied with a *Sulphureous* fluxion, then it cauſes diſmal tempeſts in the parts affected; *Convulſions*, *Epileptic* fits, *Apoplexie*, extreme *difficulty* of *breathing*, *Suffocation*, *Hyſteric* and other the like paſſions.

Now, if the Genealogie of theſe *Fluxions* here deſcrib'd, be conſentaneous to reaſon and experience; it doth not a little confirm what hath been deliver'd, touching the deprædation of the more eaſily exſoluble ſubſtance of the parts by the Spirits of the bloud. For, tho' what happens in a *præternatural* ſtate of the body, be not alwayes a good Argument of what is done in the *natural* ſtate: yet in this caſe, conſidering that the motion of the bloud, is the ſame, and that the Spirits alſo continue Spirits, in both ſtates; ſo that the whole difference conſiſts only in this, that in the fluxions alleged, the Spirits are ſuppos'd to be only deprav'd

deprav'd with *Saline* or *Sulphureous* qualities, not wholly alienated from their nature: conſidering this, I ſay, the inference I have made, is not ingenuine. For, to argue from the identity of the effect, to the identity of the cauſe, or *è converſo*, is no Paralogiſm. And ſo I conclude this not impertinent *digreſſion*. ¶.

*FROM* the cauſes and manner of the continual conſumtion of ſubſtance in Animals, we may opportunely proceed to an inquiry into the *cauſes* and *manner* of the continual *Reſtauration* of the ſame by way of Nutrition.

Of this *Reſtauration*, the *Efficient* principle (or Ἀρχὴ κινητικὴ ἢ ϕθορικὴ, (as *Ariſtotle* calls it) is certainly the very ſame with the Generant or Formative: becauſe, as I ſaid before, Generation cannot be effected without Augmentation, and Augmentation is Nutrition. Not that I am of their opinion, who hold that Life and Nutrition differ, not *in re*, but only *in ratione*; for the Human Embryo perhaps is nouriſh't before the *Empſychoſis*: but that I conceive, that *Life* conſiſts in and depends upon a continual generation of the Vital Spirits out of the moſt ſubtil, active and volatile parts of the bloud; and that *Nutrition* conſiſts in reparation or inſtauration of what is abſumed, by appoſition and aſſimilation of conſimilar or congenerous matter. So that according to the diſtinct notions I have of theſe Twinns, *Life* is maintain'd by *Diſperſion* of the moſt ſpirituoſe parts of the bloud: and *Nutrition* is, on the contrary, affected by *appoſition* and *aſſimilation* of new matter.

The *Material* or conſtituent Principle, I take to be a certain mild, ſweet and balſamic liquor, analogous to the white of an Egg, or at leaſt the *Colliquamentum*, out of which the Chick is formed. For, ſince all Animals

mals are nouriſh'd with the ſame out of which they were at firſt made up, according to that common Axiom, *iiſdem nutrimur, ex quibus conſtamus*; and that of *Ariſtotle*, *eadem materia eſt, ex qua augetur animal, & ex qua conſtituitur primùm:* and ſince they are all corporated *ex colliquamento:* we may well conclude, that the *Succus nutritius, ſive ultimum nutrimentum partium*, is in all qualities ſemblable to the *Colliquamentum* of the white of an Egg. Farre from the white of truth therefore are they who think, that the parts of the body being in ſubſtance divers, the parts of the Aliment alſo ought to be equally *divers*, as if Nutrition were really nothing but *ſelection* and *ſimilar attraction* of convenient aliment: and that there were not requir'd in every ſingle part a concoction, aſſimilation, appoſition and tranſmutation of one matter common to all. For, *firſt*, 'tis a difficult queſtion, whether there be in nature any ſuch thing as *Attraction*, or not; and to prove *Similar Attraction*, is yet more difficult: ſo that the very fundament of this opinion is merely precarious: and then 'tis moſt evident from what we have ſaid of the conſtitution and augmentation of all parts of an Embryo *ex colliquamento*, that the Aliment common to all parts, is *Similar*, not Heterogeneous: it being the proper work of the *Plaſtic* power, ſtill remaining in every Animal, as to form all the various parts out of the ſame *Homogeneous* matter at firſt, ſo to augment and repair them all, during life, out of like matter, by transforming that into the ſubſtance of every part, which is indeed potentially all parts, but actually none; as out of the ſame rain-water all ſorts of Plants receive their nouriſhment. Which is no more than what the *Philoſopher* long ſince taught, when oppoſing the doctrine of *Anaxagoras*,

*Principium rerum qui dixit Homœomeriam,*

he

he saith expressly, *Distinctio partium non, ut quidam opinantur, propterea fit, quia simile suapte natura ad simile fertur: nam præter alias multas, quas ratio ista habet, difficultates, accidet, ut quævis pars similaris seorsum creetur, verbi gratiâ, ossa per se, & nervi, & carnes, si quis eam causam amplectatur*, &c.

Finally, as to the *Manner* how this Homogeneous matter is by the Plastic power accommodated to the Refection of all the various parts of the body; most probable it is, that this admirable work is gradually done by *distribution*, *apposition*, *affixion* or *agglutination*, and *assimilation* or *transmutation:* all which acts must be *successivè* perform'd, before the operation can be complete. For the *Succus nutritius* being prepar'd, first in the Stomach and Gutts, and then in other parts to that end ordain'd, must be distributed, brought home and apponed to all parts that need refection; then from contiguity by apposition, it must be advanced to continuity by affixion or agglutination; and in fine made of the same substance with each part, by assimilation or transmutation, which is the perfection or ultimate term of Nutrition.

Now if we reflect upon what hath been here briefly said concerning the double necessity of Nutrition, and concerning the different wayes by which *Life* is maintain'd, and the *substance* of the solid parts recruited; it will plainly appear, that the *expense* of Aliment taken in by the mouth, at least of the *Chyle* extracted from it, is *double*; *viz.* that *one* part of it is converted into the *Succus nutritius*, for instauration of the solid parts; the *other* (much the greater) is chang'd into *Bloud*, which is the subject, and as it were the fewel of the *Vital Heat*. That we may therefore trace the footsteps of Nature in both these so necessary Operations, and at length discover as much of

her whole proceſſes therein, as our poreblind reaſon will permit us to diſcern; let us inquire into the Method uſed by her in the work of *Chylification* firſt, and then into that of *Sanguification*. For, theſe being well and diligently explor'd, we ſhall with the leſs difficulty comprehend the whole Hiſtory of *Nutrition* from the beginning to the end.

Begin we then from *CHYLIFICATION*, *i. e.* the turning of all the convertible parts of our Aliment or food into *Chyle*, the common matter of which both the *Succus nutritius*, and the *Bloud* are, tho' by different wayes, confected. But becauſe the Organs by Nature fram'd for, and uſed in this work, are various; and becauſe, as the Chorography of a Countrey is highly conductive to the clearer underſtanding of the Hiſtory of it, ſo the Knowledge of the fabric of thoſe Organs is neceſſarily prærequiſite to our attaining competent knowledge of their reſpective Actions and Uſes: we are therefore obliged firſt to ſurvey theſe *Organs* ſingly, and to examine the nature and frame of each apart; proceeding from one to another, according to their natural order, not of dignity, but of *poſition*; and Anatomically adminiſtring each, (that I may uſe the words of *Ariſtotle*, at leaſt if that Book *de Reſpiratione* by moſt of his Interpreters aſcrib'd to him, be truely his) κ) πρὸς τὸ ὄψιν, κ) πρὸς ἀκρίβειαν, both to ſatisfie the *ſight* of the Spectators, and to inform the *Underſtanding*, if our diligence may extend ſo farre. ¶.

HISTORIA

# HISTORIA GULÆ.

OF these Organs then, the First to be treated of is the *Pipe* or *Funnel* by which the meat and drink is carried from the mouth down into the Ventricle, to which as an Appendix it is continued.

This part hath obtain'd more than one *Name*, as well among the Antient *Græcs*, as among the *Latines*.

By *Hippocrates* 'tis sometimes call'd ὁ τῆς γαστρὸς στόμαχος, *Ventriculi osculum*, the mouth or inlet of the Ventricle, from the narrowness of it; as *in lib.* περὶ Ἀνατομῆς: and indeed among the Græcians the word στόμαχος was common to every thing that was narrow, oblong, and hollow: sometimes, οἰσοφάγος, *quasi solus comedens*, from its devouring faculty; as *in lib.* περὶ τόπων τῶν κατ' Ἄνθρωπον: to which *Aristotle* seems to allude (3. *de part. animal. cap.* 3.) where describing the *Oesophagus*, it is (saith he) *via, qua cibus & potus devoratur, ideoque nonnullis fistula cibaria dicitur.*

By the *Latines* also, in imitation of the Græcs, 'tis sometimes named *Stomachus*; as by *M. T. Cicero* (*lib.* 2. *de natura Deorum*) where he saith; *linguam autem, ad radices ejus hærens excipit stomachus, quò primùm illabuntur ea, quæ accepta sunt ore, &c.* and by *Cornelius Celsus* (*lib.* 4. *cap.* 1. & 5.) but more often, *Gula*, most probably ἀπὸ τῆς γυλίδος, which signifies a little basket or wicker snapsack, wherein souldiers upon a march used to carry their victuals; and which some wrote with a double λ; so that our *English* name, *Gullet*, from thence deriv'd, comes nearer by a little to the Original than the *French*, *Goulet*, which is abus'd to express the *La-*

*rinx* or head of the Wind-pipe. But this Latine word *Gula* is not exempt from ambiguity. For, tho' in its native and genuine ſenſe, it denote the part of an Animal now expos'd to ſight; yet ſometimes 'tis uſed to ſignifie the *fore-part* of the *neck*, as in that vulgar phraſe, *gulam frangere*; and ſometimes, any inanimate body whatſoever, that is (like the Gullet) narrow, oblong, hollow, and ending in an ample cavity; as *gula maris*, *gula montium*, *gula phialæ*; and in all Wind-inſtruments of Muſic, the neck or narrow part next to the Mouth-piece, is call'd *gula*. Here ſome perhaps may think I miſpend my time upon ſuch Grammatical niceties. If ſo, I ſhall only advertiſe them, that no leſs man than *Plato* recorded this as a maxime worthy the remark of a Wiſe man, ὃς τὰ ὀνόματα εἰδήῃ, ἴσῃ τὰ πράγματα, *he that underſtands the names of things, underſtands alſo the things themſelves.*

*In Cratylo.*

This *Gula* is not, as *Ariſtotle* (*de hiſt. animal. lib.* 1. *cap.* 2. *& lib.* 4. *cap.* 3.) expreſly affirms it to be, *Common* to all kinds of Animals whatſoever: but to all that *reſpire*. Nor is it conſentaneous, that the *neck* was deſign'd by nature for the elongation of the Gullet; (1.) Becauſe the *Vertebræ* of the neck are of themſelves ſufficient to evince, that it is ſubſervient to the various motions of the head; and in Animals of very long necks, it ſerves alſo to reach their food; as in Cranes, Storks, Swans, *&c.* (2.) Becauſe many Animals that have Reſpiration, have yet no neck, as the Toad and Frogg, among the *Amphibious*; and among *Fiſhes*, the Porcpiſce, Dolphin, with moſt, if not all others of the *Cetaceous* tribe: but on the contrary, it ſeems rather that the Gullet was made long to correſpond with the neck, that ſo it might reach from the Mouth to the Stomach: as in *Birds*. Wherefore *Fabric. ab Aquapendente*'s Climax or Ladder, which he made

made of *Aristotles* timber; *viz.* "Those Animals only "have a Gullet, that have a neck; those only have a "neck, that have a throat and wind-pipe; those only "have throat and wind-pipe, that have a voice; those "only have a voice, that have respiration; those only "have respiration, that have lungs and breast: will not bear the weight he layes upon it, every rong almost being instable. Nor can I assent to his doctrine, (*in tract. de Gula*) that all *Crustaceous*, and all *Testaceous* Fishes want the Gullet; because my eyes have assur'd me, that both *Oysters* and *Lobsters* have it, and a lively repræsentation thereof is to be seen in the figures inserted into Dr. *Willis* his Book *de anima Brutorum, ad finem cap.* 3. So that the Gullet seems to have been granted by Nature to some other Animals also, besides those that respire; for neither Oysters, nor Lobsters have respiration.

But much *Difference* of this *Gullet* is observable in living creatures of various kinds: and that in various respects. (1.) In respect of *Substance:* which in some, is more membranose; as in most feather'd fowl: in others, more fleshy; as in man, in a horse, ox, swine, *&c.* in others, almost horny, as in Crabs and Lobsters, as also in the Cormorant, which feeding altogether upon fish, and swallowing them whole even while they are yet alive, might otherwise have his gullet rased or cut by the prickles and scales of some of them. (2.) In respect of *Length:* for 'tis in some longer, as in the Giraffa, Crane, Heron, Stork, Swan, Vulture, Emeu or Cassoware, Ostrich, Onocrotalus or Pellican, or most other Fowl of the greater size: in others shorter, as in the Frogg, Crevice, *&c.* in all, according to the length of the thorax and neck. (3.) In respect of *Magnitude*; which in some is extremely great, in proportion to their bodies; as in the Gull, Duck,

Duck, Viper, Pike, and all other Animals that devour their prey whole, and ſwallow great gobbets without chewing: in others mean, as in Man and all other Animals that divide their food into morſels, and break it into ſmaller pieces by maſtication: in others again extremely little in compariſon of their bulk; as in the Whale, whoſe throat (as *Schonfeld in Ichthyologia* tells us) is ſo narrow as not to admit any fiſh bigger than a Whiting. (4.) In reſpect of *ſite*. For in Man, and in all terreſtrial four-footed beaſts, it is carried down from the root of the tongue betwixt the *Aſpera arteria* and the ſpine; and therefore the *Aſpera arteria* is made of cartilagineous circles, not perfect, but ending in a membranoſe ſubſtance, where it bears upon the Gullet, that ſo it may yield and give way to the dilatation thereof in the act of deglutition: but in moſt *Birds*, it deſcends on the right ſide of the *Aſpera arteria*, which not reſting upon it, is therefore made of perfectly circular cartilages; a pretty contrivance of Nature, and probably conducing to render the voice of ſinging birds more ſhrill and muſical. Only in the *Buſtard*, the Gullet goes winding, like the ſtreaks in the bore of a ſcrew'd gun, one whole turn about the neck. Other differences there are, but of ſo ſmall moment, that their notice could hardly compenſate your patience to hear, or my labour to recount them. Omitting them therefore, I paſs to the deſcription of it.

'Tis (ye ſee) a body round, long, hollow as a pipe, ſoft and tenſil, and therefore eaſily diſtended and contracted again both in wideneſs and length; ſo that being open'd by the meat and drink paſſing through, it naturally cloſes it ſelf again, and the ſides come together. The *upper oriſice* of it, when not uſed, is exactly conſtring'd by a tranſverſe Muſcle; as the mouth of a purſe is drawn together by the ſtrings: the *lower*

alſo

alſo is in like manner ſhutt, but by the circular fibres of the upper mouth of the Stomach.

*Placed* it is immediately behind the *Larynx:* not that by reaſon of this poſition, ſome few drops of the drink may ſlide down into the Wind-pipe to bedew and moiſten the ſides thereof; as *Fabric. ab Aquapendente* dream'd; for if we well contemplate the conſtructure of the *Larynx* it ſelf, we may even from thence be convinced, that nature was ſolicitous to prevent the falling of any the leaſt drop of liquor down into the *Aſpera arteria*, and that if any chance to ſlip down, it is by accident, and againſt her intention: but rather that the act of deglutition may be the more exactly perform'd, and to prevent the ſlipping down of any bit of meat into the bore of the Wind-pipe, to endanger the ſtopping of it; as will be more fully ſhewn when we come to conſider the reaſon of *ſwallowing*.

It deſcends in a ſtreight line betwixt the *Aſperæ arteria* and the *Vertebræ* or Sphondyls of the neck; then enters the *Thorax*, and arriving at the fourth *Vertebra* thereof, inclines by degrees to the right ſide, to give way to the aſcending trunc of the great *Arterie:* but attaining to the ninth *Vertebra*, returns a little to the left ſide; where climbing over the ſame Artery, till it come to the eleventh *Vertebra*, it paſſeth through the nervoſe part of the *Diaphragm* or Midriff toward the left ſide, by a hole clearly diſtinct from that of the great *Artery*.

The *Similar parts* of which this inſtrument of Deglutition is compos'd, are *Common*, and *Proper*. Of the *firſt* ſort, are the veſſels and outward membrane or coat, wherewith it is veſted.

*Arteries* it receives, in the neck, from the *Carotides*; in the Thorax, from the *intercoſtal*; in the Abdomen, from the *Coronary* branch of the Stomach: and

*Veins*

*Veins* in like manner, in the neck, from the *jugular*; in the Thorax, from the *Azygos* or Non-parielle; in the Abdomen, from the *Coronarie* vein of the Stomach. *Nerves* it borrows from the sixth pair or *par vagum*, and chiefly from the anterior branches of it. *Lymphæducts* it hath none, at least none hitherto have been discover'd in it; tho' some of our Modern Anatomists have conjectured, that the two Glandules on each side connected to it in the Thorax, spew out a certain humor into it, to keep it alwayes slippery and moist. But this Conjecture hath been sufficiently enervated, first by Dr. *Wharton* (*in cap. de gland. Oesophagæis*) and since by Dr. *Glisson* (*in lib. de Ventric. & intest. cap.* 1.) both adferring stronger reasons to prove, that the liquor falling from the *Tonsills* and *glandulæ Maxillares* is destin'd to the lubrication and humectation of the Gullet, all along from upper to lower end.

The *Exterior Membrane* that, to strengthen and secure it from cruentation, invests it, as the Skarf-skin do's the true skin; is deriv'd, by some from the *peritonæum*; by some, from the *Pleura*; by others, from the *Ligaments* of the sphondyls of the back; and by others again from the *Diaphragm*; and in truth it is united to all these parts, so that 'tis difficult to determine from whence it hath its *principium originationis*; unless it be lawful to say, that it arises from the first *proper tunica* of the *Oesophagus* it self, as the *Cuticula* comes from, and is sustain'd by the *Cutis*. However, consisting of only membranose fibres, and those too extremely slender; it seems to be of no other use but only to cover the Gullet on the outside, and so to prevent cruentation.

The *Proper* parts, are only two other Membranes, the *Middle* and *Inmost*.

The *Former* is very thick and fleshy, as if it were an oblong

oblong, round Muſcle bored through from end to end; whence *Hoffman* took the hint of his aſſertion, that it is really a *Muſcle*, and liable to Palſy and Convulſions. The *Fibres* of it, according to the accurate deſcription of *Steno*, are *Spiral*, and of two diſtinct orders, mutually decuſſating or interſecting each other, ſo as to make two skrews as it were running contre one to the other: and according to Dr. *Willis*'s obſervation, they ſeem to conſtitute two compound Muſcles, that make four Parallelogramms with fibres tending contrary wayes, and mutually decuſſate. And this, he ſaith, may be plainly perceiv'd by the eye, if this middle tunic of the Gullet, being dextrouſly ſeparated from the other two, be firſt tyed at both ends, then blown up, and dipp'd twice or thrice in boyling water, to ſwell or plump up the fibres: which by that means will become ſo conſpicuous, as that two contrary orders with their tendons may be diſtinctly diſcern'd. After, if the ſame tunic be turn'd the inſide outward, and again blown up; two oppoſite orders of aſcending fibres will in like manner ſhew themſelves. Laſtly, if the Tunic be cut length-ways in the middle of the tendons, and laid flatt upon a plane, two Parallelogramms will appear in one Superfice, and two other lying contrary to them, in the other. Whence it may be inferr'd, that this Middle Membrane was thus artificially fram'd by Nature, to adapt the *Oeſophagus* to all the various *Motions* requiſite to its office or uſe, *viz.* expanſion and conſtriction of its cavity, diſtenſion and contraction *ſecundum longitudinem*, and each of theſe either downward or upward, and in various degrees, as occaſion requires. Nor is it improbable, that the *Deſcending* order of double fibres is inſervient chiefly to deglutition, by conſtringing the Gullet from above downward; and the *Aſcending*, to ructation, expuition,

and vomition, by constringing the Gullet from below upward.

The *later* or *inmost* Membrane lining the Gullet, hath on its inside a kind of Scarf, thinner than Tiffany, woven of threads or fibres extremely fine; which veils its whole cavity over as it were with a downy superfice: but all the rest of it is *nervose*, furnisht with fibres of different kinds and diversly context. This Membrane is continued to that which lines the palate, throat, mouth and lipps: and descending to the stomach, covers the mouth thereof round about within, reaching three inches below it: where it appears very thick and of a close texture, discernable from the inmost Tunic of the Stomach, which there it covers, by the extreme whiteness it acquires by a little parboyling. Now from the nervose substance, and delicate interior superfice of this Membrane, 'tis not unreasonable to conjecture, that it serves chiefly to render the Gullet of *exquisite sense*. Whence perhaps it is, that we feel somewhat of complacency and pleasure from grateful meats and drinks, after they have pass'd the mouth and palate, and are entering into the Stomach: and on the contrary, of nauseousness and offense from ingrateful, even while they descend, and before they can come to displease the stomach, so as to cause it to complain to the brain of the irritation. And the deep insertion of this membrane into the stomach, even below the upper orifice thereof, may be (as Dr. *Willis* ingeniosely guesses) the reason of the intimate commerce betwixt the *Gula* and *Ventricle*, which is so great and quick, that if either be excited to expell what is offensive, the other instantly sympathizes and cooperates to its relief by vomiting, expuition, or eructation.

Having thus surveyed the whole fabrique of the Gullet, 'tis from thence sufficiently manifest, that the proper

per *Action* to which it was adapted, is *Deglutition* or Swallowing, which is thereby chiefly perform'd. I ſay *chiefly*; becauſe in truth the whole proceſs of Swallowing conſiſteth in a certain ſeries of many actions, by an admirable providence of Nature combin'd in order to one end. For, the Faculty or power of tranſmitting meat and drink from the mouth into the Stomach, is founded, not only in the *Oeſophagus*, but in many parts of the Mouth alſo; in the *tongue*, *palate*, *uvula* and its little muſcles; in the *Larynx* and its muſcles, as well thoſe that draw it up, as thoſe that pull it down; in the *Pharynx* and its three muſcles; and in the *Sphincter* of the Gullet. Yea more, there is farther requir'd alſo a concurrence of two Humors, one from the *Glandulæ Salivales*, t'other from the *Tonſils*, to render the mouth and gullet conveniently moiſt and ſlippery. For, we have it from the Oracle of Experience, that when theſe humors fail, as in Fevers they often do, the ſwallowing of ſolids becomes more difficult than the ſwallowing of liquids: and on the contrary, when they are redundant, as in Catarrhs commonly it happens, ſolids are more eaſily ſwallow'd than liquids; becauſe the muſcles inſervient to this motion, need not be conſtringed ſo cloſely to gripe and depreſs ſolids, as to ſqueez down liquids.

Now in this Syndrome or concurſe of various Actions requiſite to the whole work of Deglutition, ſome are *Præparatory* or antecedaneous: others, *conſtituent* or proper. The *Præparatory* are (1.) Direction of the meat and drink toward the *fauces* by the tongue and cheeks; (2.) Compreſſion of the Atmoſphere, or (as they vulgarly call it) *Suction*; (3.) Compreſſion of the thing to be ſwallowed, betwixt the tongue and palate, that it may tend inward; and (4.) A double *clauſure* in the throat, to hinder the ſame from ſlipping

any but the right way. All which have been so fully explain'd by Dr. *Fr. Glisson* (*de ventric. & intestin. cap.* 16.) that 'tis enough for me only to mention them.

The *Proper* also are four, *viz.* (1.) The ascent or raising of the roots of the tongue, and head of the *Larynx*; (2.) The vigoration or tension of the muscles of the *Pharynx*, whereby the orifice of the Gullet is open'd, and at the same time drawn up to meet the matter to be swallow'd; (3.) The Contraction of the *Sphincter* of the Gullet, to press the matter downward; and (4.) The *Peristaltic* or compressing motion of the same Gullet, to continue the protrusion till the matter be thrust down into the Stomach. Each of which actions, as more pertinent to my present theme, I shall endevor briefly to explicate.

(1.) The elevation or raising up of the roots of the tongue, together with the head of the *Larynx*, necessarily compresses the *bolus* sticking in the throat, and by that compression forces it into the mouth of the Gullet. For, being so environ'd, as that it cannot slipp away either by the funnells above leading to the nostrills, or by the palate, it must be cramm'd into the orifice of the Gullet: there being no other way or door left open, by which it may free it self from compression. Nor doth this compression instantly cease, but is continued till the roots of the tongue, and head of the *Larynx* filling up the whole cavity of the throat, have thence driven all the matter contain'd therein, and thrust it down into the Gullet.

(2.) Whilst this action is perform'd, the Muscles of the *Pharynx* being also vigorated, *i.e.* set on work by *tension*, cause its membrane closely to embrace the roots of the tongue and head of the *Larynx* in their ascent; but so, as that the orifice of the Gullet is at the

the ſame time carried upward, and a little forward, to meet the matter to be ſwallow'd. No wonder then, if the deſcrib'd compreſſion eaſily ſqueez into the Gullet all the matter brought into the throat: when the ſame is promoted by a *clauſure* on each ſide, from below by the aſcent of the tongue and *Larynx*, from above by the tenſion of the muſcles of the *Pharynx*; and at the ſame time the mouth of the Gullet is offer'd, as a door by which it may ſlipp away, and evade the compreſſion.

(3.) No ſooner is the matter in this manner thruſt down into the orifice of the Gullet, than the *Sphincter* Muſcle thereof conſtringing it ſelf, ſo girds the orifice, as that it not only prevents the recoiling or ſlipping back of the matter into the mouth, but ſqueezes it ſomwhat farther down. And then

(4.) The *Periſtaltic* or Compreſſing motion of the *ſpiral fibres* of the Gullet beginning, and by degrees girding the ſides thereof farther and farther downward, ſoon thruſts the matter into the cavity of the Stomach. And this ſeems to me to be the moſt reaſonable and plain accompt, that hitherto hath been given, how the whole complex work of *Deglutition* is perform'd *Mechanically*.

A work of ſo great *Uſe* to the whole body, that all men know and acknowledge it to be abſolutely neceſſary to the conſervation of the whole: Experience teaching even the moſt illiterate, that when it happens to be *aboliſh'd*, as in various diſeaſes of the throat, chiefly in inflammations, tumors, and palſeys of the muſcles of the *Larynx* and *Pharynx* it often is, miſerable famin and death inevitably inſue. It is not then without good cauſe, that Nature hath (according to her accuſtom'd bounty in works of publick utility, either to the ſubſiſtence of individuals, or to propagation of the ſpecies)

cies) to the exercise of the faculty of Deglutition annex'd an ample reward, *viz.* a grateful *Complacency* of the instruments therein used, yea a *pleasure* so inviting, that many Animals are thereby allured to hurt themselves by eating more than they can digest; and above all intemperate *Man*, whose diet is in variety of tasts the most delicious. With which vulgar remark I conclude this short and imperfect history of the *Oesophagus*. ¶.

PRÆLECTIO

# PRÆLECTIO II.

## *HISTORIA VENTRICULI.*

THAT we may not in our ſurveys divide parts that Nature hath ſo cloſely conjoyn'd, let us in the next place convert our contemplation upon the principal Organ of Chylification, wherein, as in a publick Kitchin, nouriſhment for the whole body is præpar'd, *viz.* the *STOMACH.*

This common *Receptacle* of all our meat and drink, and *Laboratory* in which all the profitable parts of both are, by the inimitable Chymiſtry of Nature, converted into a certain whitiſh liquor ſomwhat reſembling barly cream, and call'd *Chyle*; hath been by the Antient Græc Phyſicians deſcrib'd under three divers names. By *Hippocrates* 'tis ſometimes call'd γαστὴρ, from χάω *ſive* χῶ, which ſignifies to *receive* or contein, becauſe it receives all the Aliment ſwallowed down; and wherever in his works we meet with the word γαστὴρ, without addition to appropriate it to the *Head* or *Thorax*, which by him are alſo named γάστηες, *bellies*, there we are to underſtand this part alone: ſometimes κοιλίη, *i. e. Cavity*; and ſometimes κραδίη, *Heart*, from the vicinity of the upper

upper orifice of the Stomach to the Heart, and the ſymptoms thence ariſing. But of theſe Appellations, the two firſt are *common* to all great cavities or receptacles in the body: and the laſt, in ſtricter ſenſe, denotes, not the whole ſtomach, but only the principal and moſt ſenſil part of it, the *Mouth*. Among the *Latines* likewiſe we find an equal variety of denominations. For *Celſus* (*lib.* 1. *cap.* 2. *&* *lib.* 4. *cap.* 5.) uſes the words, *Venter*, *Ventriculus*, and *Stomachus* indifferently to ſignify this whole part: and *Cicero* (*de nat. Deor. lib.* 2.) expreſſes the ſame by *Ventriculus* and *Stomachus* indiſcriminately. But now uſe hath obtain'd, that the diminutive *Ventriculus* (*quaſi minor venter*) without a limitation annext, ſtand for the proper name of what the Vulgar calls the Stomach. For tho' *Anatomiſts* name the cavities of the Heart and Brain, alſo *Ventricles*; yet they never do ſo without adding, for diſtinction ſake, the name of the part, *viz.* Heart or Brain, of which they ſpeak.

This Ventricle then, being an Organical part, of great dignity, but greater neceſſity; well deſerves our ſtricteſt ſcrutiny. Let us then with diligence and patience conſider, (1.) The *Structure* or Organization, (2.) The *Elements* or ſimilar parts, and (3.) The *Actions* and *Uſes* of it. For if we can attain to a competent knowledge of all theſe things, I do not ſee what can remain to hinder us from coming at length to underſtand the nature of it fully and perfectly.

Begin we then from the *Site* or *ſituation* of it: which being not the ſame in Animals of all kinds, but various; requires to be conſider'd, firſt *in genere*, and then *ſpeciatim*; to the end that *Comparative* Anatomy may go hand in hand with ſimple or *Poſitive*.

In all Animals that have bloud, Fowls that feed upon corn only excepted, the *Ventricle* is ſeated in the upper

upper part of the *Abdomen*. The ſuperior Orifice of it, in Man, in all four-footed Beaſts, and in all Fiſhes that have lungs, is immediately under the Diaphragm: but in all Fiſhes that reſpire not, immediately appendant to the mouth; as well becauſe having neither thorax nor neck, they conſequently want the Gullet; as becauſe in them the belly is diſterminated from the mouth, by a certain membraneous partition, not much unlike to, and, as to ſeparation, ſupplying the defect of the midriff. Whereas in Animals that reſpire, the Gullet is requiſite, becauſe of the interpoſition of the breaſt betwixt the mouth and the Ventricle; which could not be commodiouſly placed above the diaphragm in the *thorax*, for more than one reaſon: *viz.* (1.) Becauſe it would have ſtraitned and compreſs'd the Lungs, eſpecially when fill'd and diſtended with food; (2.) Becauſe the *Thorax* being inviron'd with ſtrong bones, could not be diſtended enough to make room for the expanſion of the lungs, and repletion of the Ventricle, both at once; and (3.) Becauſe the ſteams ariſing from the meat and drink fermenting in the Ventricle, would much infeſt the vital parts. Which laſt incommodity, Nature ſeems to have prudently prevented, both in *Birds* that have the *ingluvies* or *Cropp* placed, not in the lower belly, but under the neck before, and without the *furcula*; and in *Fiſhes* alſo that want reſpiration: by ſeparating the heart from the ventricle with a certain membraneous partition, inſtead of a diaphragm. Again, the ſame upper orifice of the ventricle, in Man, and in all Quadrupeds, is placed immediately under the diaphragm, to prevent the farther elongation of the Gullet, which would have been unprofitable at leaſt, if not in many reſpects incommodious.

Nor is the providence of Nature leſs admirable in

placing the *Ingluvies* (in Granivorous Fowls we call it the *Kropp* or *Craw*, and the *Gorge* in Carnivorous) of Birds under the neck, betwixt the horns of the *os jugale*, call'd by us the *Fork* or *merry-thought*: she seeming to have had three inducements thereto. (1.) The Crop having no commerce with any part in the Abdomen, but only with the *Gizard*, to which it is continued by a peculiar pipe or inferior Gullet, and by which the corn steep'd and softned in the Crop is converted into Chyle; there is no necessity why it should be seated therein. (2.) The Crop serves also to keep the body of the Fowl æquilibrated upon the leggs: whereas if it were in the lowest belly, it would, when full of food, make the hinder part much too weighty for the fore part. (3.) Fowls for the most part, chiefly the Granivorous, feed their young with half-digested chyle, or corn macerated, puking it from the crop into their mouth, as is commonly observ'd in Doves and Rooks; which they could not so commodiously have done, if the crop had not been seated so near the mouth.

And as to the situation of the Ventricle consider'd *in Specie*; it is placed in the highest region of the *Abdomen*, partly in the left *hypochondrium*, partly under the pitt of the stomach, having on the right side, the Liver not only accumbent but incumbent upon it; on the left side, the Spleen adhæring to it; at the bottom, the *Omentum* or Kell or Caul fastned all along; and behind, the *Pancreas* subjacent (from thence named by some, the Pillow or Cushion of the Ventricle) and on the fore part, the *Colon*: and in this position it is establish'd by various connexions: the *superior* orifice is continued to the Gullet, and by the mediation thereof firmly annex'd to the midriffe: the *inferior*, united to the *Duodenum*, and by the mediation of the *Omentum*, connex'd to the Liver, Back, Spleen, *Colon*, and *Pancreas*.

The

The ſecond thing remarkable in the Structure of the Ventricle, is the *Magnitude* or Capacity of it: which being various, not only in Animals of divers kinds, but in ſome individuals alſo of the ſame ſpecies, chiefly in men; requires therefore to be conſider'd firſt *Comparatively*, and then *Poſitively*.

If we compare the Magnitude of the Ventricle, with that of the whole body of the ſame Animal; we ſhall find it in weight not to exceed the hundredth part of it. So that we might well admire, that a part ſo ſmall ſhould ſuffice to cook proviſion for the whole; did we not at the ſame time remember, that the Gutts help it not a little in that office.

If we compare the Ventricle of *Man*, with thoſe of other Animals; we ſhall find it to be in him leſs, in proportion to the whole body, than in them. So that *Ariſtotles* general rule (*de hiſt. animal.* 2. *cap.* 17.) *Animalia majora, majorem*; *minora, minorem habent ventriculum*; ſeems not to exclude all exception: and there is reaſon for us to believe, that Nature adjuſted the capacity of the Ventricle in all ſorts of Animals, rather to the nature of their proper food, than to the magnitude of their bodies. For (1.) Where the food is coarſe, yielding but little nouriſhment out of a great maſs; there much of it is required to ſatiate the appetite, and recruit the body; and conſequently the greater the capacity of the Ventricle. Hence perhaps it is, that the Horſe, the Aſs, the Ox, Sheep, Goats, *&c.* that feed upon herbs, graſs, hay, ſtubble, and other the like lean and poor aliments, from a great quantity of which, but little nouriſhing juice can be extracted, have great bellies. On the contrary, where the food is *rich*, *i. e.* conteining much of nutriment in a little; there is requir'd a leſs quantity of it to ſatiate the appetite, and repair the body; and by conſequence a leſs ventricle:

as in *Man*, who living upon delicate meats that nouriſh much in little quantity, hath but a ſmall ventricle, in compariſon of his whole body; and 'tis obſerv'd, that men of a more delicate diet, ſuch as is uſed at the tables of Princes and Grandees, have generally leſs Ventricles, than others that live upon coarſe fare. (2.) Animals that eat but ſeldom, ought to have the Ventricle of large capacity, becauſe they devour much at once, to compenſate their long faſting. Which is exemplified in Lions, Tygres, Wolves, *&c.* beaſts of prey, which tho' carnivorous, and conſequently of an opime or highly nouriſhing diet, are yet compell'd many times to undergo the ſharp pinches of hunger long, till they meet with food: and then they gorge themſelves, as if they intended to barrell up in their panches, fleſh for many dayes to come; and are to that end furniſhed with ample ſtowage in their bellies. The like may be ſaid alſo of thoſe Men, who are accuſtom'd to eat but *one meal* a day (whether it be a dinner or a ſupper) and that a *great* one: for by that ſurcharge, they ſo diſtend their ſtomach, as of neceſſity to render it in tract of time thinner, and by conſequence weaker, than is requiſite to health. And hence in all probability it is alſo, that great *Drinkers* enlarge the capacity of the Ventricle, by ſtretching the coats of it; till at length they come to deſtroy the tone and ſtrength thereof by habitual extenuation, and to verifie *Seneca*'s ſaying of intemperate men, (*epiſt.* 39.) *quæ fecere, patiuntur*, they are their own tormentors.

Finally, if we compare *Human* Ventricles among themſelves, we ſhall find the variety to be great, in reſpect of difference in age, ſex, ſtature, diet, and above all in habitual temperance or intemperance. Greater is the capacity of the Ventricle commonly in men than in women, in proportion to their bodies; and yet women

are

are not, as *Aristotle* believ'd, greater gluttons than men, but rather less; as having less room in their bellies to receive, and less of heat to concoct food. Greater in men of middle age, and of tall stature, than in old, and of low stature. Greater also in Gluttons and Drunkards, than in the Sober. Difficult it is therefore to determine, what is the *Positive* Magnitude of it in men; especially since we are yet uncertain, whether the Ventricle may by strong inflation or pouring in of liquors, after it hath been taken out of the body of a dead man, be brought to hold more than before while he was alive and in health. But if we may be permitted to take the gage thereof from some experiments to that end made, and from vulgar observation; we may conjecture, that the Ventricle of a man of middle age and stature, nor given to excess, cannot contain above seven pints, of sixteen ounces to the pint: and *Lossius* affirms, that he having cleans'd and dried the Ventricle of a man, together with the whole *Oesophagus*, found the weight of both together not to exceed two ounces and two drachms. Considering this, I have often admired what the grave *Plutarch* delivers concerning the draught of wine drank by *Alexander* the *Great* in the close of his last supper. For, all Historians that have written the life and gests of this great Troubler of Mankind, describe him to have been of mean stature: and the *Scyphus Herculeus* or (as *Seneca in Epist.* 83. calls it) *Herculaneus*, (a silver bowl or kind of Grace cup, consecrate to *Hercules*, in memory of his excellent faculty in drinking) is expressly said by *Athenæus* (*lib.* 11. *cap.* 9.) and by *Budæus* and other Antiquaries vers'd in the Measures of the antient Græcs, allow'd to contain *duos Congios*, two Gallons, or sixteen Pints. A huge Romer to be drank off in the end of a great Supper, and by a little man too, one at least to whom that ἄνθρωπος ἄξιον πυρρίχης

(as

(as *Euripides* calls it) or *Dignitas formæ* (as *Cicero* 1. *de Offic.*) that majeſtical ſtature ſo commendable in a Prince, was wanting. Let others believe (if they pleaſe) that he died by poiſon; I, for my part, believe, that draught of wine was poiſon enough to deſtroy him, and therefore conclude with *Seneca*; *Alexandrum intemperantia bibendi, & ille Herculaneus ac fatalis ſcyphus condidit.* Nor can I believe *Suetonius*, where among other private debauches of *Tiberius*, he relates, that one of his favorites was advanced by him to an office of eminent truſt and dignity, *ob epotam in convivio vini amphoram. Amphora enim eſt octava pars ejus vaſis, quod modium vini Galli dicunt; quodque vini tricenos ſenos ſextarios Pariſinos capit: ſextarius autem octonas eas, quas pintas vocant.*

The third thing conſiderable in the Structure of the Ventricle, is the *Singularity* of it in ſome kinds of Animals, and *Plurality* in others. To *Man*, the moſt perfect Animal, Nature hath granted but *one* Ventricle. True it may be indeed, that ſhe ſomtimes, tho' very rarely, produces men with more than one; as *Riolan.* writes, that twice he had found a double Ventricle in man; and *Sperlinger*, that he had obſerv'd the like in a woman of *Wittemberg*; and *Thom. Bartholin.* forbids us to doubt there was a double ſtomach in a man that chew'd the cudd, deſcrib'd by *Salmuth* and others: but ſuch are to be number'd among *Monſters*, of which there are ſome few among Animals of whatſoever kind.

She hath likewiſe granted no more than one to all Four-footed Beaſts, that either live upon *fleſh*, as the Lion, Panther, Tigre, Wolf, Fox, Dogg, Catt, *&c.* or have *teeth in both jaws*, as the Horſe, Aſs, Mule, Elephant, *&c.* to all *Birds of prey*, as the Eagle, Kite, Hawk, Owl, Raven, *&c.* and to all *Fiſhes* of what ſort ſoever. Nor doth it conſiſt with her wiſdom to multiply

tiply organs, where a ſingular may ſerve the turn as well: chiefly when it is of greater perfection, that one ſuffices.

I will not therefore ſay, ſhe hath been more *bountiful*, where ſhe hath doubled, or quadrupled that donative.

In all *Granivorous Fowls*, ſhe hath fram'd *two Ventricles*; the *Crop* and *Gizard*; the one, membraneous; th' other, fleſhy and muſcular: and the reaſon ſeems to be this. Theſe Fowls wanting teeth in the mouth, and for their ſuſtenance ſwallowing hard grains of corn whole; 'twas therefore requiſite, they ſhould have two Ventricles: one, wherein their hard food, mixt with the water they ſip in, might be ſteep'd or macerated, and ſoftned; another, by which the corn ſo prepar'd, might be broken, and as it were ground. For, the *Gizard* may with good reaſon be compar'd to a mill; the oppoſite ſides of its interior coat, being broad, hard, and rough, and ſo far reſembling the upper and nether mill-ſtones; and by their motion of mutual confriction or rubbing againſt each other, performing the like office that the mill-ſtones do. Again, the two contrary Muſcles inveſting that hard and rough coat, ſet and keep the mill a going; by turns contracting and moving themſelves, ſo that the rough ſides of the machine rubbing hard one againſt the other, break and grind the grains of corn lying betwixt them. And hereof, ſuch Fowls ſeem to be themſelves conſcious. For they peck up among the grains of corn, ſmall fragments of ſtones, pebbles, or flints; which being carried together with the macerated grains, out of the Craw into the cavity of the Gizard, are there of great uſe to the more facil and expedite grinding of them into chyle, ſerving inſtead of teeth. Nor do they this by chance, but guided by natural inſtinct. For before they ſwallow any ſuch ſmall pebble, they try it in their mouth, whether

ther it be angular or sharp edg'd, or not: and then if they find it to be rough and pointed, they swallow, if smooth and blunt, they reject it, as useless. So that doubtless there is Election in the case. Now those two Ventricles being necessary to the preparation and confection of the Chyle in all *Granivorous Birds*; Nature prudently furnished them with more than one: and two sufficing, she furnished them with no more.

But other kinds of Animals there are, on which she hath conferr'd no less than four Ventricles: *viz.* all that have *no teeth in the upper jaw*, as Bievs, Sheep, Goats, in a word all *Quadrupeds* that bear Horns, and all that bear no horns, and yet *chew the Cudd*, as Camels, Dromedaries, Hinds, Does, and some sorts of Sheep: not so much perhaps, because they have no teeth in the upper jaw (for they want them not, as Dr. *Glisson* well observes) as because they gather their food by whole mouthfulls at once, and so instantly swallow it; the *incisores* or cutting teeth of the lower jaw, serving them instead of cutting-hooks to shear the grass or hey, and the callose gumms of the upper, together with the tongue, serving them, instead of hands, to grasp and hold the same steady the while. So that considering, they at first swallow the food whole, they have no need of teeth above, but require to have four Ventricles for the preparation and concoction of it after. To which may be added another Use or final cause of Rumination first assigned by Sr. G. *Ent* (*in Diatrib. p.* 24.) in these words. *In hunc finem* [viz. *succi nutritii copiosiorem ex ore ad cerebrum, quod est ejusdem promptuarium, delationem*] *animalia Ruminantia cibum è ventriculo per œsophagum reducunt, ut succo ibidem expresso bis fruantur: totámque eorum palatum ex conglomeratis exilibus glandulis intùs construitur forisque tunicâ crassâ multis minimis foraminulis pertusâ, prominentiisque papillaribus loricatur.*

Of

Of these four Ventricles, common to all Animals that eat the same food twice over, *i. e.* that *Ruminate*, or chew the Cudd, the first *Aristotle* names μεγάλην κοιλίαν, the great cavity; the Latines *Rumen*; and we, the *Cudd* or *grass-bagg*: for in this, as in a Kettle, the collected food is macerated, and parboyl'd as it were, before it is return'd up into the mouth to be chew'd: the *second*, κεκρύφαλον, *reticulum*, from the resemblance the interior surface of it bears to a caul of net-work; and our Butchers, *the Paunch*; which (according to Dr. *Glisson*'s opinion) is a passage either into the first, before rumination, or into the third, after: the *third*, *Omasum*, ἐχῖνον, from the wrinkles and roughness of it; and we, the *Tripe*; the office of which is, not only to receive the food, after rumination, but farther to soften it, and pressing out the juice by closing its wrinkles, then to transmitt the same into the Fourth, reteining, by reason of its great asperity, the harder and unprofitable dreggs, to be excluded as excrements: the *Fourth*, *Abomasum*, ὄψυσεον, *quasi perficiens*; in English the *Hony-tripe*; because the many and great folds of its inmost membrane, intersecting each other, represent the cells of an Hony-comb. This Ventricle receives the half concocted juice from the third, and at length perfects the work of Chylification. But this may withal be noted, that in Calfs, and Fawns, and Lambs, while they suck; the first Ventricle remains much contracted, and the third almost empty; but the fourth bigger than the rest, which seem therefore to lye idle till the young beasts begin to feed upon grass. And the reason perhaps may be this, that Milk being very fine aliment, and so requiring no preparation, or defæcation in the other three Ventricles; is convey'd directly into the fourth; where are always found certain reliques of it, curds, whey, and somtimes

milk not yet coagulate; none of which can be found in either of the other Ventricles.

The fourth considerable in the Structure of the Ventricle, is the *Figure* or shape of it. Which when the cavity is fill'd, nearly resembles a Bagg-pipe, chiefly if the *Oesophagus* and *Duodenum* be taken in to heighten the similitude: partly *round*, that it may have the greater capacity; partly *oblong*, that it may be adjusted to the latitude of the back. *Before*, it is equally gibbose, and in corpulent men bears up the higher region of the belly; a thing by all Eastern Nations much affected, as manly and graceful: *behind*, while it remains in its place in the body, it makes two swellings, one on the right side, t'other on the left, giving way in the middle to the *vertebræ* of the back and the truncs of the great *Arterie* and *vena cava*. The *left side* or end of it is greater than the right; that on the right hand, it may make room for the greatness of the Liver, and compensate the smalness of the Spleen; perhaps also that it may be more easily exonerated by the *Pylorus*, than by the Gullet; because the peristaltic or compressive motion is alwayes stronger in a less and oblong cavity, than in one greater and exquisitely round. The *length* of it runs along from the left side to the right, not in a streight, but crooked line, making a semicircular figure representing a crescent. For, the superior orifice almost touches the Midriff; but the middle parts recede a little from it: and the *Pylorus* recurrs toward it as much, yea more, so as to make an arch; and therefore in truth, what we call the lower orifice of the Ventricle, is the higher of the two. And the reason of this exaltation of the outlet somwhat above the inlet, seems to be, lest the food, chiefly the liquid part of it, should too soon slide down out of the Ventricle; which would easily happen, if the *Pylorus* were lower.

But

But not in all sorts of Living creatures is the figure of the Ventricle the same. For in *Quadrupeds* that ruminate, the μεγάλη κοιλία or Great Ventricle is rather perfectly *round*; because being of so ample capacity, if it were extended longwaies cross the back, as the Ventricle of Man is, it would trouble the situation, not of the Liver only, but also of the other three. *Round* it is likewise in the *Rana piscatrix*, with many cartilagineous nodes on the outside opening inward; and almost round in the Hound-fish or *Galeus piscis*, nearly representing the great earthen jarrs wherein oyl is kept. But in Animals that have one Ventricle, it is for the most part *oblong*. So also is the *fourth* Ventricle even in those that chew the Cudd: perhaps that by its peristaltic motion, which (as I said afore) is more powerful in an oblong cavity, than in a round, it may the more easily expell either upward or downward what is offensive. In the *Lobster*, the figure of the Ventricle is *triangular*, that the three teeth placed within, on each side one, may be brought to touch, and by contrition grind the food.

In the last place occurr to our contemplation, the two *Orifices* of the Ventricle, both situate in the upper region thereof. Of these, that on the *left* side is sometimes call'd simply the *Mouth* of the Ventricle, sometimes by way of excellence, the *Stomach*; by the Antients, καρδία, the *Heart*; because the Affects of it cause swoonings and other terrible symptoms like those of the Heart when the pulse or motions of it are perturbed or intercepted: and this, both because of the most exquisite sense of this Orifice, which is furnish'd with various nerves: and because the Heart sympathizes with it, as well by reason of vicinity, the Stomach being but a very little distant from the cone of the Heart; as of community of nerves deriv'd from the sixth pair

or conjugation. Wider it is, and thicker than the other; but like a *Sphincter*, keeps it self alwayes contracted even to a point, unless in the time of swallowing, belching, and vomiting.

The *other* on the *right* side, call'd *Pylorus*, *i. e.* the *janitor*, tho' likewise girt about with circular fibres, is not drawn so close together, nor kept so constantly shut; only during digestion, it is somwhat contracted, so as to keep in all solids, and give way to liquids to slide down into the gutts. Dilated it is sometimes, either in great diseases, the *Lienteria*, *Cholera*, and *iliaca passio*; or in great exigents, after solid and indissoluble things have been casually swallow'd; as is evident from many examples of men, women and children, who having swallow'd gold rings, pieces of money, nutts, bullets, lizards, loches alive, *&c.* voided them by stool intire: tho' somtimes such things stick in the *Pylorus*, and produce dismal torments, and death, a memorable example whereof is recorded by that excellent Anatomist, *Theodorus Kerckringius* of *Amstredam* (*Spicilegii Anatomici observ.* 1.) in a little Girl of five years of age, who died of a stoppage of the *Pylorus*, caus'd by a Dutch *Stiver* she had swallow'd, which in her Ventricle open'd after her death, was found so firmly to have plugg'd up the *Pylorus*, that nothing could pass out by that door. And this is all the shortness of my time would permit me to speak concerning the things chiefly remarkable in the *Organization* of the Ventricle, *viz.* the *situation*, the *magnitude*, the *number*, the *figure*, and the two *orifices* thereof; as well *in genere*, as *in specie*. ¶.

We come in the next place to the visible *Elements* or *SIMILAR* parts whereof this so necessary Organ is compos'd.

Of these constituent parts, some are *Common* also to other

other organs; others *Proper* and peculiar to the Ventricle only. To the *former* classis belong the vessels, whether importing, as *Nerves*, and *Arteries*; or exporting, as *Veins*, both sanguiferous, and chyliferous: to the *later* appertain the three *Tunics*, with their *fibres* and *parenchymata*. All which require to be describ'd and consider'd singly. Which I therefore, incourag'd by your patience and attention, will endevor to do as briefly as is possible: observing the same order in which I have now mention'd them.

The *Nerves* by which the Ventricle is made participant of sense and the invigorating influence of the brain, are all deriv'd from one original, *viz.* the *sixth* pair, or *par vagum*. For, this pair, of all others the most liberal, distributes to the parts below the Midriff, four principal branches; from the anterior two, of which proceed the two anterior and superior nerves of the Ventricle; the left, from the right branch; the right, from the left: and the posterior branches, call'd by Dr. *Willis* (*in Neurologia*) the *Intercostals*, coasting along the spine of the back on each side, descend to joyn with the *superior plexus* of the *Abdomen*; and there uniting with some surcles of the anterior branches, make a little nervose chord, which connects the *Renes succenturiatos* or *glandulas renales*, and from which, as from a common stalk, almost all other parts contein'd in the *Abdomen* receive their nerves. Among the rest, some surcles shooting forth from this complication, and accompanying the *Cœliac Arterie*, distribute themselves, partly to the bottom of the Ventricle, partly to the left prominency of it, and partly to the spleen. The Ventricle then being thus plentifully furnish'd with nerves, and those too continued to the principal branches that send forth surcles to most other parts in the same great cavity contain'd: it seems not difficult to conjecture,

conjecture, that the remarkable consent and sympathy betwixt those parts and the Ventricle, arises chiefly from that community of nerves; nor to give a probable reason, why vomitings usually accompany the *Colic*, *Hypochondriac* winds, and *Hysteric* fits; the irritation being, by continuity of the nerves, easily propagated from one part to another.

The *Arteries* that continually bring in bloud and life to the Ventricle, are reckon'd to be in number five, each served by a *vein*, to export the bloud after it hath done its office of heating, cherishing, and enlivening. These Arteries and veins are call'd, *arteria & vena pylorica*; *arteria & vena gastro-epiploica dextra*; *arteria & vena gastrica*, from whence proceeds the *coronary* branch; *arteria & vena gastro-epiploica sinistra*; and the *vas breve arteriosum & venosum*. All the divarications and branchings of which vessels, discernable in the coats of a human ventricle artificially blown up, are most accurately represented in the first table of Dr. *Willis*'s Book intitled *Pharmaceutice Rationalis*: whither, for expedition sake, I refer the unsatisfied: meanwhile commending to their notice three observables concerning these numerose vessels.

(1.) That they all tend *inwards*, and in their progress subdivided into innumerable spriggs smaller still and smaller, till they dwindle into Capillaries, are at last terminated in the inmost coat or nervose membrane of the Ventricle; infecting the interior surface thereof with redness, as if it were bloudshot. Which will be conspicuous, if after the Ventricle hath been blown up, and dipt a little in boyling water, it be turned the inside outward, and the downy lining neatly separated: for, then the innumerable terminations of the arteries and veins, will appear to cover the nervose membrane, as with a bloudy nett.

(2.) That

(2.) That their capillary ſurcles are *equally* diſpers'd upon all parts of each Tunic, as if their uſes were thereby ſignified to be equal in all parts. This alſo is apparent to ſenſe; for, tho' all the three Tunics be white, yet in living diſſections, wherever the Ventricle is prickt with the point of a needle, there will be ſeen bloud to wooz forth.

(3.) That the Arteries and Veins reſpectively official to them, are exactly proportionate among themſelves, as well in the amplitude of their truncs, as in the diſtribution of their branches, and in the portion of the Tunic to which they are diſtributed: ſo that the vein correſpondent to each artery, is adjuſted to export as much bloud, as the artery imports. Whereas in moſt, if not all other parts of the body, the arteries are generally obſerv'd to be leſs than the reducing veins: becauſe in thoſe, the motion of the bloud is ſtronger and ſwifter; in theſe, weaker and ſlower. This proportionate diſtribution is moſt clearly diſcernable in the branches of the *Gaſtric* vein and artery, which in their Coronary divarications, no leſs than in their truncs, are exactly correſpondent each to other. The reaſon whereof, according to the judgement of Dr. *Gliſſon*, who ſeems firſt to have remarkt the thing, may be becauſe the arteries and veins have their origines near at hand and together, and the three laſt have theirs from proportionate veſſels, the Splenic artery and vein; not that they bring in any thing from the Spleen to the Ventricle (as the Antients, ignorant of the Circulation of the bloud, erroneouſly held) but that they are more commodiouſly derived from thence, than they could be from any other veſſel whatever; the vicine ſituation of the Spleen conſider'd.

The *Venæ lacteæ* of the Ventricle appear to be but few, in compariſon of the great multitude iſſuing from

from the Gutts. Dr. *Gliſſon* tells us, that thoſe ſhew'd to him by Dr. *Wharton* in the Ventricle of a Dogg diſſected alive, were not many: adding this deſcription of them. They took their original (*ſaith he*) from the bottom of the Ventricle, and not far from thence, ſupported by the anterior membrane of the *Omentum* or kell, they were carried along to the greater Glandule thereof; and after entrance into it, they crept along the right margin of the *Pancreas*; then ſuſtain'd by the *Meſentery*, they went on directly to the Common Receptacle, and into that diſcharg'd their milky freight. And this perfectly agrees with what I have more than once obſerv'd, and can viſibly demonſtrate in living diſſections of Doggs. 'Tis ſomwhat ſtrange then that the curious Dr. *Willis* ſhould never perceive any of theſe Chyliferous veſſels in the Ventricle; or at leaſt, not ſo much as mention them in his Anatomic hiſtory of that part, wherein he pretends to ſo much accurateneſs: but much more ſtrange, that he ſhould in the ſame book teach, that the ſanguiferous veins of the Ventricle take in part of the Chyle out of its cavity, and carry it immediately into the maſs of bloud; when if he had conſidered the uſe of the Glandules of the Meſentery, and the ſeparation of the purer parts of the Chyle from the impure and excrementitious, performed in the Gutts; he might have inferr'd from either of thoſe reaſons, that while the Chyle remains, either not perfectly concocted, or not ſufficiently defæcated, in the ſtomach, no part of it ought to be ſo immaturely commixt with the bloud. But this is my opinion, and that was his: and therefore every man is free to approve which he thinks moſt conſentaneous.

As for *Lymphæducts*, if we take them as contradiſtinct to the *Venæ lacteæ*; hitherto I have heard of none diſcover'd, and therefore believe there are none in the Ventricle;

Ventricle; the rather becauſe there are ſome *Venæ lacteæ*, which are congenerous to them; nor is it Natures uſe to multiply kinds of veſſels, where one kind is ſufficient. True it is indeed, that in the Meſentery, both *venæ lacteæ* and *lymphæducts* are found: but this objection hath been fully anſwer'd by Dr. *Gliſſon* (*in libr. de ventric. & inteſt. cap.* 3. *num.* 8.) ſaying, that thoſe veſſels differ more in reſpect of the liquors they carry, than of the ſtructure or conſtitution of their ſimilar parts. For, the *Lympha* is a thin, hungry liquor; the *Chyle* thicker, ſucculent, and rich: *this* is brought from parts newly recruited with freſh aliment; *that*, from parts that want refection: though both are diſcharg'd into the *Common Receptacle*. Wherefore although *Lymphæducts* paſs through the Meſentery, yet are they not to be reputed the genuine veſſels thereof, but aliens travelling along the neareſt way through it. And if they ſtaid to bait at any part well ſtored with Chyle, 'tis probable the liquor they would ſuck in, would make them of the ſame milky colour with the true *venæ lacteæ*. And theſe are all the *Common* Similar parts of the Ventricle. ¶.

The *Proper* are (as I ſaid afore) three *Tunics* or Membranes, with their *Fibres* and *Parenchymata*.

The three *Tunics*, although they ſeem to cohære but ſlightly, ſo that being moved by a little impulſe of the finger any way, they ſlip one upon another; are notwithſtanding connected with that pretty artifice, that each hath its Fibres implicated with thoſe of the next; which fibres muſt be dextrouſly cut off, before the Tunics can be ſeparated, whether the Ventricle be raw or boyl'd.

That which firſt offers it ſelf to the view, is the *Exterior Tunic*; which ſome will have to be borrowed

of the *Midriff*, and others, from the *peritonæum*: both which opinions will be found light, if put in the ballance againſt the moments of reaſons brought to refute them, by the moſt judicious Dr. *Gliſſon* (*de ventric. & inteſt. cap.* 4. *num.* 2.) who with more juſtice affirms it to belong to the Ventricle by right of origination, as properly as either of the other two; at leaſt in reſpect of its peculiar *fibres* and *parenchyma*. Thicker it is, and furniſh'd with more nervoſe fibres, and conſequently ſtronger than any membrane deriv'd from the *Peritonæum*: in ſubſtance, texture, and courſe of fibres, exactly reſembling the exterior coat of the Gullet; ſo that if ye remember our deſcription of that, ye will need no other idea of this. The *uſes* of it are many, *viz.* (1.) To inveſt, and corroborate the Ventricle, and to preſerve it from cruentation on the convex ſide; (2.) To ſuſtain the great multitude of veſſels that are divided and ſubdivided into innumerable ſurcles, as they diffuſe themſelves betwixt it and ſecond or middle coat; (3.) To conſerve the heat of the Ventricle, ſo requiſite to concoction; (4.) To concurr to the *periſtaltic* motion of the ſame, which it doth by vertue of its tranſverſe fibres contracting or ſhortning themſelves ſpontaneouſly. Here recurrs to my memory a certain *Pathological* remark added by Dr. *Willis* to his deſcription of this utmoſt coat of the Ventricle: "I have obſerv'd (ſaith he) in the bodies of "many who had long languiſh'd under loſs of appetite, "continual nauſeouſneſs, and frequent vomitings, diſſe-"cted after death; that ſomtimes a ſeroſe humor, ſom-"times an effuſion of biſe, ſomtimes an abſceſs, upon "the outſide of the Ventricle, had by irritation of it, "been the cauſe of thoſe diſmal ſymptomes. A ſingular obſervation, which I the more willingly recount, becauſe 'thas been my luck once or twice to meet with the like.

The

The second or *Middle* Tunic is much thicker and more fleshy than the first, laced every where with fibres, and consequently both stronger, and more potent to perform the *Peristaltic* motion, to which chiefly it seems to be adapted. The *position* and *course* of these *fibres* are various in the various parts and sides of it. On the *Concave* or inside, strong fleshy fibres run down obliquely from the left hand toward the right, till they arrive at the bottom: so that when they contract themselves, they must of necessity pull the bottom of the Ventricle obliquely upward toward the left orifice; and therefore conduce to vomiting and other expulsive motions by the same. On the *top* or ridge of the same convex side, are many fibres of a distinct order, which hemming in the left orifice of the Ventricle, tend to the right, and rising a little therewith, cover it, and then terminate therein. So that they seem, by their action, which is contraction, to bring the right orifice nearer to the left, which is alwayes done in vomiting: which motion being continued somtimes even to the bottom of the *Duodenum*, both the *Bile* or Gall, and *Pancreatic* humor are pumpt up into the stomach, and thence ejected by vomit. On the *Convex* or outside, are likewise fibres of two sorts, tho' both *circular*. For some incircling the mouth of the stomach, where the *Oesophagus* ends, gird it about, and so close it: and others, incomparably more in number, incompass the whole Ventricle, tending from the upper parts, to the bottom, in parallel lines, and thence ascending again from the bottom to the top, like so many Zones or girths: so that when they are put into action, they must needs bring the bottom of the whole Ventricle nearer to the top, and the sides also nearer together, and so lessen the cavity thereof; so that whatever is at that time contain'd therein, being rais'd upward and prest on

every side, can hardly evade being expelled by one of the two orifices, or by both; as it often happens from violent irritations of the stomach, and alwayes in the *Cholera*.

Now from these various orders of strong fleshy Fibres wherewith this Middle coat is garded, we may easily collect, that it was so fram'd by Nature, to be the principal instrument of the *Peristaltic* motion of the stomach, as well as to corroborate and defend it.

The third or *Inmost* Membrane, is remotely different from either of the other two. For, in *substance* 'tis, though not wholly *nervose* (as most Anatomists have affirm'd) yet much less *fibrose*, and less *tenacious* or tough, and consequently less *extensible*. Which seems to be the reason, why Nature has made it so much *larger* than either of the two coats that invest it, that when by their compressive motion or contraction, the cavity of the Ventricle is minorated, this falls into many *wrinkles* or plaits, and so remains till the Ventricle be again distended by repletion, and then all the wrinkles disappear: the largeness compensating the want of tenacity, and the wrinkles making it capable of equal extension with its fellows, without danger of rupture. Moreover, the *inner surface* of it is *spongy* or porose, and unequal; as being cover'd with a downy veil consisting of threads exremely fine, and perpendicularly inserted into the coat, resembling the right side of velvet or plush. A singular artifice of Nature, and such wherein she seems to have had more than a single aim. For (1.) This plushy lining serves to *defend* the coat from the injuries of solid and hard meats, which otherwise might, by their immediate contact, offend and irritate it. (2.) It conduces somwhat to the firmer *detention* of the meat, and not yet perfectly concocted Chyle; which otherwise, if the

superfice

ſuperfice of this coat were ſmooth and polite, would eaſily ſlip down too ſoon. (3.) It helps to *cover* the extremities of the innumerable arteries and veins terminate in this coat, and ſo prevents the *cruentation* of it. (4.) It makes way for the *exſudation* of humors brought thither with the bloud, by the arteries. For, in Man and all Carnivorous Animals, the Ventricle is alwayes found to be ſmear'd all over within, with a certain ſlimy or *pituitoſe humor*, which ſticks ſo faſt to the inner or pluſhy ſurface of this Coat, as if it were a kind of vegetable growing out of the pores of it. Which *Mucus* or *Phlegm*, tho' an *Excrement* in reſpect of the whole maſs of blood, from which it was by ſecretion ſeparated; is nevertheleſs of great uſe to the Ventricle into which it is excern'd; and that in three conſiderable reſpects. (1.) By lining the concave ſide of this inmoſt membrane with its mucilagineous ſubſtance, it ſerves to ſecure it the more from Cruentation. For though the ſtomach of a dead man, when invers'd, doth not appear bloudy, even after this *Mucus* hath been wiped or ſcrap'd off; perhaps becauſe the motion of the bloud is then ceas'd, and the cold of death hath ſhut up the pores by which it might wooz out: yet in the living, this *Mucus* cannot be wholly purged away, but cruentation will ſoon inſue; as is ſeen in the *Dyſenterie*, and *ſuperpurgations* by violent and corroſive Medicaments, in which caſes bloudy ſtools happen, and yet without the rupture of any veſſel, or exulceration of either Ventricle or Gutts. (2.) The ſame *Mucus* conduceth to render the inſide of this coat more *ſlippery*, ſo that it may more eaſily expell any offenſive matter, upward or downward, as occaſion requires. (3.) By growing *acid* or ſowre, it ſerves, both to excite hunger, and to facilitate the diſſolution and fermentation of the meat and drink in the ſtomach.

Of

Of this *Mucus* much more might here be said, did I not foresee that I shall be obliged to resume it, when I come to inquire into the actions and uses of the Stomach. Meanwhile I must not omitt to observe, that the *Convex* side of this Plushy lining of the inmost Membrane thereof, is set thick with small Glandules: which Dr. *Willis* conjectured to be there placed, both to cover the mouths of the arteries and veins there terminated, and to receive and separate some humor, by way of percolation; nor do I dislike that conjecture.

We are now arrived at the two last of the proper constituent parts of the Ventricle, the *Fibres* and *Parenchymata*; which will fully compensate our patience, if we fix our thoughts awhile upon the consideration of them.

The various significations, and more various Etymologies of the Latine word, *Fibra* (about which there has been no little hacking and slashing among Grammarians) I willingly pass by; and with *Salmasius* deriving it from the *Æolic* φιξὸν *pro* λεπτὸν, which according to the interpretation of *Hesychius*, denotes a *soft* and *slender* thread; take it, according to the use of Anatomists, to express a certain similar part, nearly approaching to the nature of a nerve, and continued to one, but much more slender: so that I am apt to believe it to be a single filament elonged from some nerve, after its division into many threads, each as fine as that spun by the Silk-worm, if not finer. The best description of it, that I have hitherto read, hath been given us by Dr. *Glisson* (*de ventric. & intestinis cap.* 4.) which I will therefore recite, as worthy to be known by those who have not perused that most elaborate Book, and to be revived in the memory of those who have.

*A Fibre is* (saith he) *a body in figure like a thread, slender,*

*ſlender, tenacious, tenſil and irritable, made of a ſpermatic matter, and deſtined to ſome motion and ſtrength.*

(1.) *In figure like a thread, i. e.* oblong, round and ſmooth; (2.) *Slender*, as a Spiders thread; (3.) *Tenacious, i. e.* tough, or whoſe parts firmly cohæring, are not eaſily broken; (4.) *Tenſil, i. e.* capable of being extended in length, the latitude the while diminiſh'd, and of being thickned in bredth, the longitude the while abbreviated; (5.) *Irritable, i. e.* ſuch as may be by irritation excited to contract it ſelf, and is naturally apt to relax it ſelf again, when the irritation ceaſeth; (6.) *Made of a Spermatic matter, i. e.* if it be a naked or ſimple fibre ſuch as thoſe of all the Muſcles; but if ſtufft with any parenchyma, perhaps then not made of only a ſpermatic matter, and ſuch are all the fibres of the Ventricle and Gutts; (7.) *Deſigned for motion and ſtrength*; becauſe being of a tough conſiſtence, it cannot but add to the ſtrength of a part; and being capable of extenſion and contraction, it muſt therefore be deſtined to motion.

This deſcription, though true and plain, ſeems yet ſomwhat too narrow to comprehend the whole nature of Fibres generally conſider'd. Let us therefore enlarge it by ſubnecting a few lines more, concerning the conſtitution, uſes, action and paſſion of them.

(1.) The *Conſtitution* of a Fibre is either *inſita* or *influens*, native or adventitious. The *Native* is again Similar, or Organical. The *Similar* conſiſteth in a matter fitly diſpoſed, in a juſt temper, corpulency, cohærence of parts, tenſibility, flexibility, continuity, hardneſs and ſoftneſs. The *Matter* is wholly *Spermatic*, although ſometimes it be ſtuff'd with a bloudy pulp, as is obſerv'd in the fibres within the Ventricles of the heart. Wherefore the native *temperament* of all fibres is cold and moiſt indeed, but enrich'd with delicate and noble

noble ſpirits, however fixt: and conſequently they require to be nouriſh'd with a ſpermatic aliment. The *Corpulency* or fleſhineſs of fibres is variable, ſomtimes greater, as in ſtrong and laborious men; ſomtimes leſs, as in weak, lean and ſedentary. The *Cohærence* of parts ought to be firm and tough, that they may be extended without danger of divulſion or rupture, and return to their natural poſture, by ſpontaneous contraction, after extenſion. Their *Flexibility* depends, partly upon their tenacity, partly upon their middle conſtitution betwixt hardneſs and ſoftneſs; that they may be neither rigid or ſtiff, nor flaggy.

The *Organical* native conſtitution of fibres, conſiſteth in their due ſituation, figure, magnitude and continuity; all which are included in their former deſcription.

The *influent* conſtitution of them, is either *Vital*, or *Animal*. If the *vital* influx be deficient, the force and ſtrength of the fibres ſoon languiſhes, as in ſwoonings and faintings. Yea, if it be but depraved, as in fevers, their vigour in a few hours decayes. If the *Animal* influx be intercepted, as in the palſy; they quickly become languid and ſtupid: yea, if the brain and nerves grow dull and ſluggiſh, the fibres at the ſame time grow flaccid and looſe, unapt for vigorous motion.

(2.) The general *Uſes* of all fibres are to corroborate the parts to which they belong, and to move them. The ſpecial uſes are various, reſpective to their various formation in divers parts: as (for inſtance) in the Stomach and Gutts, they ſerve chiefly to their *Periſtaltic* motion.

(3.) The *Action* of Fibres is either Common, or Proper. *Common*, when being invigorated, *i.e.* ſet on work by extenſion, which is againſt their nature, they pull and move the part to which they are connex'd;

as

as a chord pull'd by a mans hand, pulls a plummet or any other body faſtned to it: but this ſeems to me to be, in ſtrictneſs of truth, rather *Paſſion*, than action, in reſpect of the fibres themſelves; for, they ſuffer extenſion, being, notwithſtanding their natural renitency, ſtretcht in length, by the pulling of the nerves from which they are elonged. Wherefore (according to my weak judgment) their *Proper* action is only *Self-contraction*, by which they reſtore themſelves to their natural poſture. A motion common indeed to all *Tenſil* bodies whatever; and therefore rightly term'd by Philoſophers motion of *Reſtitution*; the cauſe whereof I take to be the ſtrong cohærence of the parts of which they are compos'd. If ſo, what need we amuſe our ſelvs by ſtriving to deduce the ſpontaneous Contraction of nerves and fibres, either from *natural Inſtinct*, which implying I know not what ſecret ſuggeſtion, *pro re nata*, from ſome forein cauſe, whether God, or His ſervant Nature, is to me unintelligible: or (what is equally abſtruſe) from *Natural Perception*, which ſuppoſes even inanimate things, yea every the leaſt particle of matter in the whole Univerſe, to be naturally endowed with knowledge of what is good or evil to their nature, with appetites to embrace the good, and eſchew the evil; and with power to move themſelves accordingly: faculties that my Philoſophy will not grant to any but rational creatures?

(4.) The *Paſſion* therefore of a Fibre, is the extenſion of it, which is a paſſive motion coming from a cauſe without the eſſence of the fibre it ſelf. Which cauſe, unleſs it actually relax or ſtupefie the fibres, incites or irritates them to contract themſelves: and the more violent the irritation, the ſtronger is the renitency and ſpontaneous contraction; as is obſerv'd in convulſions. To me it ſeems impoſſible, that a ſimple fibre ſhould

by its own action alone extend it self in length: nor have I wit enough to conceive how this can be done: since all extension is a less or greater degree of force tending to the tearing asunder of the parts of the tensible body, against which divelling force the firm cohærence of the parts makes it strive. And as for the *Cessation* of fibres; that is when they neither act, nor suffer, but rest from all either extension or contraction, having restor'd themselves to their natural posture of laxity. This they attain to chiefly in sleep, when all fibres of the whole body, (those that serve to respiration and the motions of the heart, only excepted) are at rest, and thereby refresh'd, acquiring after labour and wearines, new strength and vigor, from the sweet, mild and balsamic juice dispensed to them from the brain by the nerves.

After this concise survey of the fibres in the membranes of the Ventricle, there remains only their peculiar *Parenchyma* to challenge our observation: which it may with the greater right pretend to, because there are many who question whether it be real, or imaginary; because the whole Ventricle being of a white color, seems therefore to be made up only of fibres and membranes. It concerns us then to be certified (1.) Of the real *existence*, (2.) Of the *necessity*, (3.) Of the *quality*, and (4.) Of the various *uses* of what we call the *Parenchyma* of the Ventricle, as a distinct part thereof.

(1.) To be assured even by our own eyes, that there *is* really such a thing; we need only to essay the excarnation of the stomach, by laying it extended upon a plain bord, and then scraping it moderately hard with a blunt knife; in the same manner as Sheep skins are scrap'd by those who make Velom and Parchment; or gutts by those who make Sawciges. For, by this easie means, you may scrape off so great a quantity of soft

ſoft white pulp, as will by nineteen parts of twenty exceed all that you leave behind of membranes and fibres, which will yet remain as ſtrong and tenacious as they were before. Againſt which experiment, I ſee not what can be objected. For if the firm cohærence of the fibres of the Stomach be not only not aboliſh'd, but not at all diminiſh'd, by this ſcraping away of the pulp that ſtufft them; it follows, that the pure fibres, in which alone the ſtrength of the ſtomach conſiſts, ſtill remain intire, and that nothing but the *Parenchyma* or pulp hath been taken away. From the ſame experiment it appears alſo, that the membrane and pure fibres of the Ventricle are in themſelves pellucid or tranſparent; as we ſee in the skins of Sawciges: and that they owe all their opacity to their ſtuffing with this *Parenchyma*.

(2.) Which is *neceſſary* to the conſtitution of the Stomach, in more than one reſpect. *Neceſſary* it ſeems to fill up and make ſmooth and plain the inequalities ariſing from the contexture of the fibres, which running various courſes, and riding each over other ſomtimes, would otherwiſe render the ſurfaces of the membranes uneven. *Neceſſary* it is alſo to ſtop the pores of the Stomach, that it may hold liquors the better, and be ſtanch even to vapors and wind: as linnen cloth is made to hold water by dipping it into melted wax, oyle and turpentine, which fill up the void ſpaces betwixt the threads, in the ſame manner as this mucilaginous pulp fills up the interſtices betwixt the fibres, and ſo makes the membranes impervious. *Neceſſary* it is to the augmentation and extenuation of the fibres themſelves. For, the fibres of the Stomach, although ſeldom or never liable to fatneſs, are yet eaſily capable of plumpneſs and leanneſs. In men ſick of a Conſumtion, they are alwayes extenuated: in fat men, alwayes plump

and thick. But these mutations could not so easily happen, if the fibres were not stuff'd with some pulp: for all *Parenchymata* are easily melted away by degrees, but fibres not without great difficulty; nor do I know any thing more apt to colliquate their substance, and destroy their tone, than Brandy and other corroding Spirits, how highly soever extoll'd by Chymists that distill them. We may see in men languishing of Hectic fevers, and ulcers of the lungs, the Tendons of the muscles remaining intire, when the pulp of them is in the mean time almost wholly consumed. Whence 'tis evident, that the fibres, which are more easily obnoxious to augmentation and diminution than other solid parts, have much of a pulpy substance in their composition.

(3.) This *pulp*, if softned and diluted with water, is like a mucilage or gelly; otherwise, tenacious, tensible, and strong, like paste: so as to be impervious to winds and liquors, though apt perhaps to imbibe the thinner and spirituose part of the Chyle. Different from the Parenchyma of the bowels; and from that of the Muscles also: as being neither bloody, but white and spermatic; nor congested into a mass, but spread abroad, like plaister, so as to bear extension and contraction together with the fibres; part of it being stuff'd or cramm'd into the fibres, the rest dawbed upon and betwixt them, so as to fill up and plane their interstices.

(4.) Besides which two *Uses*, it seems to serve also to three others: *viz.* to the safe conduct of the *Venæ Lacteæ* proceeding from the Stomach, which probably have their roots in the *parenchyma* of the inmost tunic thereof, where the small Glandules observ'd by *Steno* and *Malpighius*, are seated: to the separation of the *mucus* or *pituita emortua* from the bloud brought by the arteries into the coats of the Ventricle; of which we shall more opportunely inquire, when we come to the

*uses*

*uſes* of the Stomach : and laſtly to make way for a larger current of blood to paſs through the membranes of the Stomach, than otherwiſe they and their pure fibres could through their ſubſtance tranſmitt. For, Fibres, by how much more firm and tenacious they are than the Parenchyma is, by ſo much more they reſiſt the tranſition of the blood : and therefore if here were no *Parenchyma*, certainly the Ventricle would be irrigated with more ſlender ſtreams of blood, and conſequently colder than it ought to be. Whereas now no leſs than five conſpicuous arteries diſcharge themſelves into its coats. Certain therefore it is, that a more liberal afflux of bloud is requir'd to the conſtitution of the ſtomach, than ſeems poſſible to be tranſmitted through the naked membrane and fibres without this pulp.

Having now at length finiſh'd (I wiſh I might ſay, perfected) my ſurvey of all viſible Elements, or conſtituent parts of the Ventricle; I ſhould proceed to the functions, actions and uſes of it. But remembring that an empty Stomach hath no ears, and conſidering that it would be double wrong to you, ſhould I at once ſtarve both your bodies and your curioſity: I chooſe rather here to break off the thread of my diſcourſe, than to weaken that of your life, by detaining you longer from neceſſary refection. ¶.

PRÆLECTIO

# PRÆLECTIO III.

## Of the ACTIONS and USES of the VENTRICLE.

*AFTER dinner sit a while*; is an old and good precept to conserve health. Let us then (if ye please) now observe it. And that we may repose without idleness, let us calmly inquire into the method, causes, and manner of *Digestion*: resuming the clew of our discourse where hunger and thirst brake it off, when it had brought us to that place, where we might most opportunely consider the *ACTIONS* and *USES* of the Ventricle, whose admirable *Structure* and various *Parts* we had so particularly contemplated, in order to our more accurate investigation of them.

In this disquisition, Nature her self hath plainly mark'd out the steps wherein we are to tread; having assign'd to the Ventricle eight distinct operations or actions to be perform'd in order successively. These *Actions* are (1.) *Hunger*, (2.) *Thirst*, (3.) The *Peristaltic motion*, (4.) *Reception*, (5.) *Retention*, (6.) *Concoction*,

*coction*, (7.) *Secretion*, (8.) *Expulsion*: each of which hath a peculiar *Faculty* respondent to it; for every action *in specie* distinct, necessarily implies a distinct power. But because each distinct faculty, and the action respondent to it, are, though in reason different, yet in reality one and the same thing: I shall not treat of them separately, but describe them together under the more familiar name of *action*; the rather because if we can be so lucky to find out the true reason of any one operation here specified, we need search no farther to know the nature of the faculty to which it belongs; all *mechanical operations* conducting our understanding to the knowledge of the proper *powers* by which they are perform'd. Following then the order of Nature in examining these Actions, I begin from the first, *viz. HUNGER.*

1. HUNGER. Among the many differences betwixt *Plants* and *Animals*, this is not the least remarkable; that *Plants* are fixt by their roots which serve them also instead of mouth and stomach, in the earth, so that they remove not from their places in quest of nourishment: *Unde facundiss. noster* Entius (in Antidiatribæ pag. 5.) *Plantæ*, inquit, *non sunt quidem* gressiles, *sed humo affixæ, secum continuè habitant: quòd pluviâ solùm ac rore (tenuissimo scilicet victu) pascantur. Ideoque cùm ad rivulos potatum ire nequeant, expansis veluti brachiis, facundos imbres à* Jove pluvio *implorant*: But *Animals* having their Stomach within their bodies, and sucking no juice immediately from the earth, are therefore forced to change their stations, and range from place to place to find food convenient for their sustenance. And because the capacity of their Ventricles and Gutts, is not so great, as at once to contain a quantity of food sufficient to maintain life for many dayes together;

necessary

neceſſary it is, they ſhould often be recruited by eating freſh aliment. To obtain which, they muſt ſeek it: and to oblige them to ſeek it, they muſt be excited and urged by ſomthing within them to that queſt: and to that excitation is requir'd an internal goad as it were, and that a ſharp one too and irreſiſtible, the inevitable neceſſity of their nutrition conſider'd: otherwiſe they would neglect to ſupply themſelves in due time with new ſuſtenance, and conſequently ſoon pine away, and periſh. Now the goad that compells them to feed, is *Hunger* and *Thirſt*; the one urges them to ſeek *meat*, the other, *drink*: both by *Ariſtotle* expreſs'd by the name of *Appetite*; by *Galen* call'd *Senſe*; and by Dr. *Gliſſon* (who from the ſingular goodneſs of his nature, took pleaſure to reconcile the different opinions of the Antients) more truly defin'd to be, *Appetite* of meat and drink, conjoyn'd with *Senſe* of the want of them. For, impoſſible it is, an Appetite Senſitive ſhould be excited to deſire, unleſs there be repreſented to it an object to be deſired. If therefore, according to *Ariſtotle*, hunger and thirſt involve the Appetite of meat and drink, it præſuppoſes a ſenſe of the abſence of them. And granting a ſenſe of them as things deſirable, there is neceſſarily excited an Appetite of them. For, ſenſe of want is of its own nature querulous and craving: and by how much more important to the conſervation of life the thing wanted is, by ſo much the more urgently doth it ſtimulate the Appetite to crave it. Whence it follows of neceſſity, that hunger and thirſt are both *Appetite* and *Senſe*; *quod erat probandum.*

To diſpell all umbrage of doubt that may ariſe from ambiguity of words, to eclipſe this verity; it concerns me to put ye in mind, that *hunger* and *thirſt* are each of them taken in a *double* ſignification; ſomtimes for the *object* of which the ſtomach is ſenſible, ſomtimes

for the *affect* of the ſtomach by which its appetite is excited. In the *former* acception, by hunger or thirſt is meant only the *want* of meat or drink in the ſtomach: in the *later*, a ſenſe of that want, together with an *appetite* of one of the two. Now according to the *former* of theſe two notions, the truth is, neither hunger nor thirſt can be either ſenſe or appetite; but the *objective cauſe* of both: but according to the *later*, each of them is both ſenſe and appetite. And that this *later* is the moſt proper and commonly receiv'd notion, is evident even from hence, that frequently there is want of meat in the ſtomach, when there is no ſenſe of that want, and then it is not call'd hunger: as in fevers, and after profuſe vomiting. The ſame is confirm'd by that diſeaſe call'd *Appetitus caninus*, a Dogg-like appetite, in which tho' the Stomach be even ſurcharged with abundance of meat, yet ſtill it craves more, and ſends up to the imagination a ſad complaint, that it feels hunger, and deſires a farther ſupply of meat. We may therefore from both theſe oppoſite inſtances conclude, that *Hunger* doth properly ſignifie *ſenſe* of *want* of meat; and *Thirſt*, *ſenſe* of *want* of drink: and conſequently that one includes *Appetite* of meat; the other, *Appetite* of drink, to ſupply that want.

But what kind of *Senſe* is this by which the Stomach perceives the want of food? Is it referrible to any of the five external ſenſes? Or do hunger and thirſt conſtitute peculiar ſorts of ſenſes proper only to the ſtomach?

I *anſwer*, that the ſenſes of hunger and thirſt ſeem to have great cognation with the ſenſe of Touching, as alſo with thoſe of taſting and ſmelling; and yet notwithſtanding are, not only gradually, but *ſpecifically diſcrepant* from every one of them. For, Faculties are *in ſpecie* different among themſelves, if they neceſſarily require

require absolute Constitutions *in specie* different, in which they may be founded. For a sensitive Faculty is really nothing else, but an *aptitude* of the *sensorium* to perceive: and this aptitude is of necessity diversified, if the absolute constitution, in which it is rooted, be divers. Now that the senses of Hunger and Thirst necessarily require an organ or *sensorium* in a peculiar manner framed, that they may therein be founded; is sufficiently manifest even from this, that no part of the whole body, but the Stomach only, is sensible of the want of meat or drink. In the last degree of a Consumption, call'd *Marasmus*, in which all parts of the body are extremely emaciated, and in want of nourishment; there is no part, but only the Stomach, touched with sense of hunger: and in a fever likewise, though almost all parts be parch'd and dried by heat, yet none feel thirst, but that to which the faculty of thirsting peculiarly belongs, which is the Stomach. Certain it is then, that to the founding of these peculiar Faculties, a peculiar constitution, whether similar, or organical, and such as is diverse from that in which the faculty of Touching is founded, is of necessity required: seeing that the sense of Touching is exquisite in many parts of the body, in which notwithstanding neither hunger nor thirst is ever felt. Wherefore the sense of Touching is of a different kind from those of hunger and thirst.

Besides, the *pain* of the Touching is specifically different from the pain of hunger and thirst: as every man may observe in himself, if he compare the one with the other, either at divers times, or together, in the same organs: if he estimate them at divers times, he shall easily distinguish the gnawing trouble of extreme hunger, from exquisite pain of his stomach: yea it frequently happens, that vehement pain of the sto-

mach prevents hunger, or extinguiſhes it; and on the contrary, that hunger is then ſharpeſt, when the ſtomach is free from pain. If he compare them when they are *coincident*, he ſhall even then perceive a manifeſt difference betwixt the pain of the ſtomach, and the craving ſenſe of hunger. Nor is it indeed poſſible that theſe ſenſations ſhould be not ſpecifically diſcrepant each from the other; becauſe two Accidents of the ſame ſpecies cannot at the ſame time inhære in the ſame ſubject: becauſe one will neceſſarily drown the other.

As for the ſenſes of Smelling and Taſting; true it is indeed, that they have ſomwhat more of affinity to hunger and thirſt, than that of Touching hath; for they both judge of the qualities of the meat and drink, before they are admitted into the ſtomach; and hunger hath ſo powerful an influence upon them, that the taſt and ſmell of the very ſame viands that are moſt grateful to an empty ſtomach, become loathſom to a full one: and yet notwithſtanding this affinity, they are ſenſes ſpecifically different from both hunger and thirſt, as is moſt evident even from hence, that they are founded by Nature in organs of peculiar conſtitutions, and accommodate to the perception of their proper objects. Conſtant therefore it is, that hunger and thirſt are querulous ſenſes, and ſpecifically diſcrepant from all other ſenſes, and peculiar to the Ventricle. Which is the propoſition here examined.

I add, that they are *eſſentially different alſo one from the other*, though ſeated in one and the ſame organ. But this poſition being much more nice and intricate than the former, requires us to conſider them apart, that we may the more diſtinctly inveſtigate the peculiar nature and proper eſſence of each. Begin we then from

from *HUNGER*; inquiring (1.) What is the Object of it, and (2.) What the Constitutions of the Ventricle, wherein it is rooted.

The *OBJECT* of Hunger is either *absent*, or *present*: the *former* of which is, not only specifically different from, but in some sort opposite to the *later*. For, the *present* object is displeasing and troublesom to the stomach: the *absent*, grateful, and when present, satisfactory.

(1.) The *Absent* object proper to hunger, I conceive (with our most excellent Dr. *Glisson*) to be that *nutritive Succulencie* or juicinesse, which all wholsom meats contain in them more or less, and which being alterable, is apt to be changed into Chyle; *viz.* a certain substance or matter, mild, tender, easily mutable, abounding in sweet and fixt spirits, not destitute of fatness, temper'd with a due portion of earth, and condited with some salt of its own. These are the qualities of that matter which I call *succulent* and *nutritive*, and which I hold to be the proper absent object of the faculty of feeling hunger. For, all aliments contain in them copious *spirits*, and those for the most part *fixt*; which the stomach, by inducing fermentation upon them, excites, and brings to a certain moderate *fluor*, that they may more commodiously be thence transmitted into the milky veins, and become nourishment, partly to the bloud and vital spirits, partly to the spermatic and solid parts of the body. They all contein also some *fat*, more or less, in them; which fat, as the Oracle of experience teacheth, is highly profitable to appease the importunity of hunger, and desirable for nourishment. In fine, they all contein also somwhat of *salt* and somwhat of an *earthy* substance; and without the alloy of these two ingredients, neither could the spirits conserve their fixation, nor the fat its

its ſweetneſs. Now this nutritive Succulency, the proper object of hunger, is ſaid to be *abſent*, not that it is perpetually ſo, or that it is not perceiv'd when it is preſent; but only becauſe in the principal action of the Faculty, namely *hunger*, from which the whole is denominated, it is *really abſent*. Beſides, the utility of things is better underſtood by the want, than by the full fruition of them: nor ſhould we take notice, that the ſtomach perceives the meat contain'd in it, and is therewith appeas'd and ſatiated; unleſs we were ſomtimes urged and moleſted by hunger upon the want of meat. However, moſt certain it is, that this *Object*, when *preſent*, is alwayes perceiv'd by the ſtomach with complacency and delight: and when *abſent*, is much more eſteem'd: and therefore the object, in hunger, is juſtly call'd *abſent*; and the whole Faculty as juſtly defined, *Senſe* of hunger, and *Appetite* of meat.

(2.) The *Præſent* object, is that offenſive and gnawing kind of pain that moleſteth the Stomach, whenſoever it wants and craves meat. The formal *Reaſon* of this ingrateful ſenſation, ſeems not to conſiſt (as our Maſter *Galen*, and the whole Schole of Phyſicians ever ſince his dayes have taught) in a certain *Suction*; for neither can any of the conſtituent parts of the Ventricle cauſe any ſuch motion in it, nor can the Ventricle ſuck it ſelf, becauſe no natural Agent can do an action diſpleaſing to it ſelf: but to ariſe merely from *Acid* humors contain'd in the cavity of the ſtomach; which by *aſtriction*, *aſperity*, *roſion*, and *fretting* of the inmoſt membrane of the Stomach (as if they endeavor'd to draw forth a tincture from it) cauſe it to feel a kind of *Vellication* or gnawing, and to complain to the imagination of the want of that mild, ſweet and nutritive Succulency, that is requiſite to mitigate and extinguiſh that offenſive Vellication, and to induce complacency

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in the room of it. And these Acid humors in this manner causing a sense of Vellication in the Ventricle, seem to be, partly the *reliques of meat* still remaining in the cavity thereof, partly the *sowre Phlegm* brought with the arterial bloud into the inmost tunic of it, and there separated: of both which we shall have occasion ere long to speak more opportunely. Mean while, having thus concisely proposed to your more judicious examen, what seem'd to me most probable concerning the *double object* of Hunger; I haste to the *Constitutions* of the Stomach, in which that offensive sense of want of meat is founded.

These *CONSTITUTIONS* are (according to the division of the parts of the Ventricle mentioned in my first Lecture) either *common*, or *proper*. The *Common* are (1.) The *Temperament*, (2.) The firm *Tone*, (3.) The *Cavity*, (4.) The *Asperity* of the inmost coat, (5.) The acute *Sensation*, and (6.) The *Porose* or spongy *substance* of the same inmost coat of the Ventricle.

Among these, the first place is due to the *Temper* of the Stomach; upon the justice of which the natural vigor of this Faculty of craving meat, so necessarily depends, that if but the *influent* temper (to prætermitt the *insite* or native) happen to be deficient, or depraved; the appetite soon comes to be impaired or vitiated accordingly. Of this we have an eminent instance in a *fever*, which no sooner invades, than it dejects all appetite of meat, inducing great thirst in the room of it: and the reason seems to be this, that by the febrile heat of the bloud brought into the inmost tunic of the stomach by the arteries, the *acid ferment* therein lodged is destroyed. For *Acids* (ye know) are apt to extinguish thirst, and all inflammations of the bloud augment it, by overcoming their acidity.

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The *second* is due to the *firm Tone* of the membranes and fibres of the Ventricle. For if this *Eutonia* of the whole organ be any way vitiated, the appetite of neceſſity more or leſs languiſheth, flaggs, and vades: becauſe the ſtomach, having its fibres relaxed, can neither contract it ſelf enough to embrace the food it receives, nor be duely ſenſible of the complacency thence reſulting. For, both the relaxation, and the infirm cohærence of the tone of any part, very much diminiſh the vigor of it, and induce ſluggiſhneſs and ſtupidity inſtead of it. How requiſite to the excitation of a good appetite, the firmneſs of the tone of the ſtomach is, may be collected, not only from the experience of great *Drinkers*, who by exceſſive diſtenſion of the coats, by continual ſoaking the fibres, and by diluting and rinſing away the *Acidum eſurinum* (as *Helmont* calls it) of the ſtomach; have little or no appetite to wholeſom and nutritive meats, and at length ſo ruine the tone of the ſtomach, that they become inſenſible of hunger, and dye languiſhing, moſt commonly of Dropſies (ſome of the *Lymphæducts* being broken in their bellies) or Conſumptions from want of nouriſhment: but alſo from our own obſervation of the diminution of our hunger, in the heats of Summer, and the reviving of it in Winter. The reaſon of which remarkable alteration and viciſſitude, ſeems to conſiſt in this, that in the Summer, the whole body being as it were diſſolved and enervated by immoderate heat, and the ſpirits continually exhauſted by ſweats and profuſe tranſpiration, the tone of all parts becomes ſofter and more lax than it ought to be in the ſtate of health; and conſequently the appetite of the ſtomach to ſolid meat, dwindles into thirſt: but in Winter, when all parts are conſtringed and render'd more denſe by cold, the appetite grows ſtrong again, and craves more of ſolid meat

meat to ſatiate it. Which doubtleſs was well underſtood by the wiſe Author of that vulgar Aphoriſm (*lib.* 1. *aphor.* 15.) *Ventres hyeme & vere ſunt natura calidiſſimi, ſomnique longiſſimi: iis igitur temporibus cibi acceſſio eſt adjungenda*, &c. and which holds true alſo in hot and cold countreys compared together. This may be farther confirm'd from hence alſo, that as all remedies uſed by Phyſicians to relieve languiſhing ſtomachs, have ſomwhat in them of *aſtriction*; as wormwood, roſes, mint, coriander, quinces, pomegranates, and generally all acids: ſo all that ſoften and relax the tone of the ſtomach, weaken the appetite; as ſyrup of Althæa, violets, conſerve of mallows, oyl of ſweet almonds, fat pottages, *&c.*

The *third* conſtitution requiſite to hunger, is a *juſt capacity* of the ſtomach. For, if the ſtomach were not hollow within, it could be neither ſenſible of emptineſs, nor capable of repletion. If its cavity be not of a juſt magnitude, it can neither crave, nor receive a proportion of food neceſſary to ſupply the indigence of the body. Hence it is, that ſuch who have the ſtomach leſs than is fit, are commonly ſubject to frequent vomitings after full meals: and that on the contrary, they who have wide and deep paunches, often eat more than they can digeſt, and ſo render themſelves liable to ſurfeits.

The *fourth* is, a moderate *Aſperity* or roughneſs of the inmoſt membrane of the ſtomach. For, where this is wanting, as in the *Lienteria* it alwayes is; there the appetite continually languiſhes, till it be wholly extinct. And all *Lubricantia*, or things that induce a complanation and *ſlipperineſs* upon the inſide of the Ventricle, whether they be *alimenta* or *medicamenta*, ſenſibly blunt the edge of hunger; as Manna, Caſſia, Elect. Lenitive, *&c.* as on the contrary, all things that

conſerve or increaſe the aſperity of the lining of the ſtomach, as verjuice, unripe fruits, pomegranate flowers and rinds, *&c.* whet the appetite.

The *fifth* is, an acute *Senſation* of the ſtomach. For, were the ſtomach a part endowed with a dull ſenſe, how could it be ſenſible of the vellication of hunger? 'Twas not therefore without ſingular providence, that Nature made the inner ſuperfice of the Ventricle extremely tender and delicate, and diſpers'd ſo many nerves (more than can be found in any other part) upon the membranes compoſing it; more particularly upon the ſuperior orifice of it, where hunger ſeems chiefly to reſide. And it hath been obſerved by Phyſicians, that in what maladies ſoever the nerves of the ſtomach are diſaffected by relaxation, ſtupefaction, or diminution of the Animal influx from the brain; in the ſame the appetite is equally injured and dull'd; as in the Lethargy, inveterate Scorbute, Tabes dorſalis, *&c.* Manifeſt it is therefore, that an acute Senſation is requir'd to the perception of hunger.

So is alſo (in the *ſixth* and laſt place) a *Poroſity* or ſpungineſs of the inmoſt membrane of the ſtomach. For if the pores happen at any time to be fill'd up with the mucus or dead Phlegm ſeparated from the bloud in that membrane, as uſually they are in leucophlegmatic Virgins, and ſuch as are troubled with the Greenſickneſs; or dawb'd over with any viſcous humor, and cloſed up, as in all ſcirrhoſe tumors of the Ventricle they always are: in either of theſe caſes, the Appetite fails, the membrane ceaſing to imbibe the Chyle. Hence moſt probably it is, that mints, red roſes, marmalade of quinces, and other the like grateful Aſtringents, which are otherwiſe beneficial to the ſtomach, prove highly noxious, if uſed by thoſe who have obſtructions in it: when wormwood, wine, ſteel, and

almoſt

almoſt all Aperient remedies, in that caſe excite and revive the languiſhing Appetite. Evident therefore it is, that to complete the reaſon of Hunger, is requir'd at leaſt a freedom of the inmoſt Tunic of the ſtomach from obſtruction.

Having thus run through the *Common* conſtitutions of the Ventricle, in which Hunger is neceſſarily rooted, we are arriv'd at the *Proper*: of which there are two *Organic*, and one *Similar*.

Of the *Organic*, the *firſt* conſiſteth in the *wrinkles* and *folds* of the inmoſt membrane of the Ventricle, which being larger, and capable of greater diſtention than the two that inveſt it, cannot therefore be conſtringed by their contraction, without falling into wrinkles or folds. Now this Corrugation both augments the Aſperity of the inner ſurface of this Tunic, and makes it more ſenſible of emptineſs, which is a part of hunger, and ſuch a part, without which the eſſence of hunger cannot be intire or complete: in both reſpects not a little conducing to the more eaſie and effectual perception of the vellication of the fibres by the Acid ferment.

The *other* conſiſteth in the *nakedneſs* of the ſame ſuperfice of the inmoſt membrane, which renders it more apt to perceive, both the ingrateful gnawing of the Acid humors, when it is empty; and the grateful juice of meat, while it is repleniſh'd; the very nerves lying bare to the touch of both.

The *Similar* (and laſt) conſtitution proper, wherein hunger is founded, is a certain *prædatory* or devouring *quality* of the ſame inmoſt membrane of the Ventricle, conſiſting in an *acid* imprægnation, by which it is adapted to diſſolve, melt, and ferment ſolid meats, ſo that being commixt with liquids, they are changed into a milky broth or *Chyle*. Here we find an eminent

inſtance of that vulgar axiome, that Nature takes the moſt *compendioſe* way to attain to the ends at which ſhe aims, as often as is poſſible, deſigning one inſtrument to various effects. For, this very ſimilar conſtitution, in which the faculty of *hunger* is chiefly founded, is the fundament alſo of the principal faculty of the ſtomach, the power of *Concoction*. And hence it is, that if at any time the *Digeſtive* power happen to languiſh, the *Appetite* alſo grows proportionably dull and weak; and on the contrary, while *that* continues in vigor and full energy, *this* likewiſe is quick and ſharp: as if they were two ſtalks ſhooting forth from, and dependent upon the ſame root, they thrive and decay together. True it is (I confeſs) that there ſomtimes occurr to the obſervation of Phyſicians certain anomalous caſes, in which this confederation fails; the Concoctive power of the ſtomach being much dejected and weakned, while the Appetite is but little diminiſhed; and on the contrary, the Appetite being weak, where the Digeſtion is good and laudable. But this faileur always happens where all the conſtitutions, in the ſyndrome or concurſe of which the Appetite of meat is founded, are not coincident with that conſtitution, in which the power Digeſtive is rooted: in which caſe commonly men are greedy of, and cramm their ſtomachs with more meat, than they can digeſt, to the great detriment of their health, and the generation of crudities, the common ſeminary of many diſeaſes, the origin of which is to be aſcribed to the *diſproportion* betwixt the forces of theſe two confederate powers, the Appetite and the faculty Digeſtive. Let thoſe therefore, who have this Appetite in exceſs, to prevent the innumerable evils conſequent to ſurfeits and crudities, obſerve the good old rule of riſing from the table before they have ſatiated it: becauſe in them, *Satiety* is not the meaſure of eating, as it

it is in others, in whom the faculties of hunger and concoction are (as they ought to be) æquivalent. For, according to the inſtitute of Nature,

This *Satiety* is a certain grateful ceſſation of the ſenſe of hunger, ariſing from a perception of moderate repletion of the ſtomach with food. For, the ſtomach being replete, the ſenſe of inanition immediately ceaſeth; becauſe the inanition it ſelf is then taken away. Beſides, the ſucculency and nutritive benignity of the meat, foments as it were, and cheriſhes the nakedneſs of the inmoſt tunic of the ſtomach, mitigating the querulous ſenſation of it, and inducing a complacency in the room thereof: and at the ſame time, the ſowr reliques of the former repaſt, and the Acid Phlegm in the ſtomach, being contemper'd by the mild and ſweet juice of the meat, gnaw and vellicate the ſtomach no longer, but ſet themſelves to act upon the newly receiv'd aliment, and by their acidity to melt and diſſolve it. So doth alſo the Prædatory and Chylific quality of the ſtomach it ſelf, having new matter whereon to exerciſe its corroſive and diſſolving energie. So that upon this ſaturity or repletion, the ſtomach ſoon finds a kind of delightful ſatisfaction within it ſelf, and by the mediation of its nerves, communicates that grateful ſenſation to the brain: and in this manner the induſtry of Animals, excited by the ſharpneſs of hunger, and imploy'd in queſt of nouriſhment, is when they have obtain'd it, fully recompenſed with the pleaſure of repletion.

But the government of this mighty Prince, *Hunger*, is (as other Empires) liable to great and dangerous diſorders, ſomtimes too remiſs and diſſolute, ſomtimes corrupt, and ſomtimes tyrannic: whence ariſe various diſeaſes and ſymptomes that perturb, pervert, and not ſeldom alſo ſubvert the whole Oeconomy of the body.

Theſe

Theſe may be commodiouſly refer'd, either to the *Diminution*, or to the *Exceſs*, or to the Depravation of Hunger: to

*Diminution*, when the Appetite is *leſs* than it ought to be: which is commonly call'd, by the Græcs, Ἀνορεξία, by the Latins, *dejectio appetitûs*, and by us, weakneſs or decay of appetite: and divided into *Simple* dejection, and dejection mixt with *nauſeouſneſs* or loathing. The *former* is varied by degrees, according to the leſs or greater læſion of the faculty, and the variety of the conſtitutions in which the ſame is founded; as may be eaſily collected from the accompt I have given of thoſe conſtitutions. The *laſt degree* of Diminution is named by ſome, Ἀποστία, *proſtratio appetitûs*; by others, Ἄπεινα *ſive* Ἀπείνη, *fames planè abolita*; by others again, Ἄλιμος, *ſimplex carentia famis*, but (as hath been well obſerved by the moſt accurate Dr. *Gliſſon*) improperly, becauſe the word, Ἀλιμος ſignifies rather the *cauſe* driving away hunger, than the abolition of it. In this extreme debility, the Conſtitutions of the ſtomach proper to this faculty are ſo far infringed and hurt, that they neither perceive the inanition of the ſtomach, nor complain of the want of food. The *later* is ſubdivided into *Nauſeouſneſs* or loathing *cum materia*, whether meat lately eaten, or vitioſe humors congeſted in the ſtomach; and *ſine materia*, when the prædatory conſtitution of the inmoſt membrane of the Ventricle, which conſiſteth (as I have ſaid) in *Acidity*, is alienated from its nature and proper object; as alwayes it is in fevers, the inflammation of the bloud being *è diametro* repugnant to that acidity, and inducing inſatiable *Thirſt*, inſtead of moderate hunger.

The vice oppoſite to this, is *Augmentation* or Exceſs of hunger; which likewiſe afflicts in various degrees, the laſt of which, is diſtinguiſht from the reſt by the peculiar

peculiar appellation, βούλιμος, *vehemens fames*, and κυνώδης ὄρεξις, *appetitus caninus*. In this exorbitant Affection, the prædatory quality of the Stomach is highly intended, and becomes outragious, even to cruelty: and for the same reason, the Acid phlegm, which the inmost membrane spews out into the cavity of the Ventricle, acquires a greater and sharper acidity, that even corrodes the nerves and fibres, like Worms incessantly gnawing them. Hence the stomach is afflicted with great anxiety, and by reason of the excessive strength of its prædatory constitution, devours, digests, dissolves, dissipates and consumes whatever is brought into it in a trice, and when full, still craves more; seldom ceasing, till surcharged, it be forced to eject, upward or downward, what it hath lately devour'd with insatiate greediness. If therefore any of the *Virtuosi* should interrogate me concerning the monstrose *Voracity* of some Gluttons, such as were *Wood* the great Eater of *Kent*, and *Marriot* (whom most of the Seniors here present (I believe) knew, at least by sight) I should venture to ascribe it, partly to the extraordinary *amplitude* of the stomach in such unhappy men; for otherwise where can they have stowidge for so great a mass of meat, as they usually devour at a meal: but chiefly to a certain piercing and *corrosive Acidity* lodged in the cavity of the stomach, that both renders their hunger insatiable, and dissolves and consumes the meat almost as fast as they swallow it down. And this Conjecture seems to me the more probable, because *Marriot* himself more than once told me, that his Greedy worm (as he call'd it) first began to bite him, within two or three dayes after he had eaten a large break-fast of a salted gammon of Bacon. For, certain it is, that salt, though it retain its native savour, while it continues fixt, doth notwithstanding, when brought to the state

of

of *fusion*, acquire *acidity*; and that so much the more sharp and fierce, by how much the nearer it is, by fermentation or heat, advanced toward the state of *volatility*: nor is any thing more solenne to *Chymists*, than to draw out of salts distill'd, liquors acid and corrosive to the last degree, illustrous examples of which we have in the spirits of common salt, nitre, and vitriol. Why then may it not be supposed, that the like effect may be somtimes produced in the body of man? that the great quantity of salt eaten by *Marriot*, being partly by the heat of his stomach, partly by fermentation therein made, brought to a state of *fluxility*; and commixt with his bloud, be farther advanced to so high a degree of *volatility*, as to become extremely *corrosive?* If this be supposed possible, 'twill not be found unreasonable to guess, that the *Mucus* or *pituita emortua* spew'd out by the arteries into the inmost tunic of his Ventricle, and impregnate with corrosive Acidity, might be the principal cause of his excessive Appetite, and of the quick dissolution and consumption of whatever he devour'd. So that in strict truth, his stomach, not he, was the great Eater; or rather the corrosive acidity of humors contein'd in his stomach.

The *third* enormity incident to this faculty, is *Depravation* of appetite, call'd in the general, *Pica*, in women with child, *Malacia*: seldom afflicting men, frequently women, and among these such chiefly who have either the green sickness, or great bellies; and proceding in them *à suppressis Catameniis*. Which stagnating *circa uterum*, and acquiring a peculiar kind of corruption; when they have therewith infected the whole mass of the bloud, leave such a vitious tincture in the *Mucus* or dead Phlegm thereof, separated from the bloud in the inmost coat of the stomach, as that from thence arises a perverse hunger, not of good and wholesom

wholesom meats, but of things absurd and uncouth, such as chalk, loam, charcoal, ashes, unripe and austere fruits, turfs, and other the like trash. If I do not persue this extravagant Appetite farther in this place, 'tis not because I have no more to say concerning the Conjunct Cause of it; but because the Law of decency obliges me to be reserv'd, where the Argument belongs only to the knowledge of the grave Physician, who alone is priviledg'd to philosophize chastly περὶ γυναικείων. Contenting my self therefore with what hath been said concerning the first *Action* of the Ventricle, *Hunger*; I proceed to contemplate the nature of the *Second*, viz. *THIRST*. ¶.

II. *THIRST.*

The Faculty of *THIRST* is also necessary to nutrition, as respecting the *Vehicle* of solid aliment, whereby it is diluted, and reduced into a thin and liquid substance, call'd *Chyle*. Yea more, a Vehicle is requisite also in respect of the *Bloud*, which would be of too thick a consistence, and unfit to perform its circuits round the body, if it were not now and then diluted by fresh supplies of drink: nor could this Vital Nectar be commodiously purged and defæcated from various impurities and excrementitious parts, namely the *Bile*, *salt*, *tartar*, and *mucus*; unless it were daily rinsed as it were with a sufficient portion of thinner liquor. For, it is by the help of our drink alone, that the saline and earthy excrements of our bloud are driven out by urine. Ye may add yet another use of liquids suggested first by Sr. G. *Ent* (*in Antidiatribæ pag.* 28.) in these words. *Quo chyli pars tenuior expeditius* [*è ventriculo per œsophagum, per viam* filtrationis, *ad cerebrum*] *sursum ascendat, humectatione opus est; quemadmodum in filtratione usu venit: atque hinc etiam potandi necessitas; sicca enim ascensum hujusmodi frustrantur. Idcóque ar-*

*dente febre correpti, quibus lingua faucésque arent, subitò macrescunt.* And these are the principal reasons that seem to have induced Nature to institute *thirst*, or Appetite of *drink*, in all Animals.

That this Appetite of drink is *seated* in the Ventricle, as in its *subject*, can not be denyed: but that it is confined to the Ventricle *only*, can not be granted. (1.) Because drink receiv'd into the stomach, doth not always mitigate thirst: and therefore that part of thirst that remains after a competent quantity of drink, must reside in some other parts vicine to the stomach. For, it is unconceivable that the stomach, when replete with cold and moist, should still feel and complain of want of both. (2.) Because they who in fevers are tormented with insatiable thirst, complain not so much of heat in the stomach, as drineſs and parching of their tongue, throat and gullet. Nay they find more alleviation and relief from frequent washing of their mouths and throats with fountain water, small beer, and other convenient liquors; than from all the cold drink they can pour in. The like solace they find also from holding in their mouths, such things as any way promote the flowing forth of the *Humor Salivalis* or spittle, though they be neither actually cold nor moist in themselves; such as Prune stones, polisht Crystal, pieces of gold (all which by their weight and pressure upon the tongue, further the profusion of the spittle) and *sal prunellæ*, which detain'd only in the mouth, and there slowly melted, palliates the thirst. We may therefore conclude, that the adæquate subject of thirst includes not only the *Stomach*, but the *gullet* also, and the *throat*, with the *tongue*: all which are cover'd with one and the same membrane, and must therefore sympathize.

The

The *OBJECT* of this faculty is (as of Hunger) twofold, *Abſent*, and *Præſent*. The *Abſent* Object is in the general, whatſoever liquor is fit to be drunk, and to ſatisfie thirſt. For we thirſt after Wine, Water, Beer, Ale, Whey, Cydre, and any other delectable juice or tincture whatſoever. But to render any of theſe, or any other Potulent matter, the genuine and formal object of thirſt, are requir'd theſe *Conditions* following.

(1.) That it be *liquid*, or *fluid*, like water. For ſolid bodies are unapt to quench thirſt, unleſs they be ſuch as may be melted or diſſolv'd in the mouth, or by irritation cauſe the glandules of the mouth to diſcharge the ſpittle ſooner or more copiouſly, than otherwiſe they would do: which is but to abate thirſt by accident, as a pipe of Tobacco ſomtimes doth, only by bringing rheum down, that moiſtens the mouth.

(2.) That it be *Humid* or moiſt alſo, at leaſt effectively. For certainly whatſoever potulent matter appeaſes thirſt, doth ſome way or other moiſten the parts that were dry and thirſty before. Vinegre and Sal prunellæ, though in ſome reſpect they may be ſaid to be cold and dry; yet being taken into the mouth, may be nevertheleſs allowed to mitigate thirſt, in ſo much as they diſſolve the viſcid and aduſt humors adhæring to the ſurface of the tongue, and open the ſluices of the ſpittle, that were before obſtructed.

(3.) That it be *thin*, *penetrating*, and in ſome ſort *cutting* or ſharp. *Thin* it muſt be, to irrigate the thirſty parts the ſooner: but not too thin, leſt it ſlide away before it hath moiſtned them, which perhaps is the reaſon, diſtill'd waters, without any other mixture, are ineffectual to quench thirſt: but a little thickned with cooling ſyrups, and contemper'd with acids, they make good julebs to that purpoſe. It muſt be *penetrating* alſo, and *ſharp* or acid, to inſinuate the deeper into the

membrane which is the ſeat of thirſt, and moiſten more than the ſuperficial parts thereof. For, daily experience teaches, that thick, viſcid, ſweet and heavy drinks, rather increaſe than abate thirſt. It appears then, that the formal reaſon of drink, in reſpect of which it is ſaid to be the abſent object of thirſt, doth conſiſt in its *fluidity*, *humidity*, moderate *tenuity*, and aptitude to *penetrate* and *cutt*.

If any accuſe me of forgetfulneſs, for that I have here omitted to liſt *coldneſs* among the qualities of drink moſt convenient to extinguiſh thirſt; I intreat ſuch to take notice, that I did it *ex profeſſo*: diſſenting from this opinion of the *Peripatetics*, that the abſent object of thirſt, is *frigidum & humidum*. For, in the Schole of experience I have learn'd, that drinks *actually* hot quench thirſt, as well as actually cold; witneſs thoſe many hundreds of men now living in this City, who alwayes warm their ordinary drink, and yet are ſeldom or never moleſted with inordinate thirſt. And as for drinks *potentially* hot; many of them alſo mitigate thirſt: as ſeveral ſorts of wines, as well ſtrong and generous, as weak and ſubacid; as alſo ſtrong beer, and Hydromel. Notwithſtanding theſe obſervations I deny not but liquors, whether actually or potentially cold, *cæteris paribus*, are to be preferr'd by men in health, as to the extinction of thirſt.

The *Manner* how we become *ſenſible* of thirſt, ſeems to be, not poſitive, but *negative* or privative. For the parts in which thirſt is placed, perceiving themſelves to be drier than their natural conſtitution requires, tranſmit to the brain, by the nerves, their ſenſe of the want of convenient liquor to moiſten and relieve them: and this ſenſe of want being thus propagated to the internal ſenſe, whoſe organ is the brain, inſtantly ſtimulates it to deſire and ſeek after drink, to ſupply that want.

The

The *Præsent* Object, that causes the sensation of this defect of moisture in the external organ, and more urgently soliciteth the phantasy than the Absent object doth; consisteth in the adventitious and offensive *drineſs* of the membrane investing the stomach, gullet, throat and tongue. Which being ordain'd by nature to be perpetually irrigated with a certain mild humor; whensoever that irrigation fails, immediately perceives its natural constitution to be changed, and communicates that ungrateful perception to the nerves, and by them to the brain. But this *Drineſs* which we conceive to be the præsent object of Thirst, is not so much a *superficial* siccity (though that also is perceiv'd) as a *profound* and *internal* in the membrane therewith affected: and in that very respect clearly differs from that external siccity, that falls under the perception of the sense of *Touching*. For the Touch judges indeed of drineſs, but only as of an object occurring from without, not as of an intrinsecal affection of its own organ, wherewith it is profoundly altered. And hence may be collected that conspicuous and evident distinction between the sense of *Thirst*, and the sense of *Touching*. The Touch perceives the superfice dry or moist, of another body: the sense of Thirsting, on the contrary perceives the internal and profound drineſs of its own organ, the membrane in which it resides. For example, a man in a burning fever, may with his finger feel the drineſs and asperity of his tongue; but not his thirst: nor is the finger, or any other part of the body, howsoever dry and parch'd, ever sensible of thirst, but only the membrane to which Nature hath confined the sense thereof. Nor doth this membrane perceive thirst by the same sense of Touching, by which it feels external objects that touch it, but by a certain faculty proper and peculiar to it self. *Wherein then doth that peculiar Faculty consist?* Certainly

in

in the syndrome or confederation of its *Constitutions*.

These CONSTITUTIONS (as those in which Hunger is founded) are either *Common* or *Proper*. The *Common* are (1.) Exquisite sensibility, (2.) Tenderness, (3.) Mobility, (4.) Permeability, (5.) Cleanliness of the membrane or proper organ. The *Proper* are the native moistness, the proclivity to dryness, and impatience of bearing that dryness without anxiety, of the same membrane. Of each of which Constitutions I shall speak singly, but briefly.

(1.) That the Organ of Thirst is of *delicate sense*, is evident even from this, that it is endowed also with the faculties of touching and tasting: for needs must that part be exquisitely sensible, which is the subject of three several senses. It was not then for nothing, that Nature made it nervose, and furnish'd it with plenty of nerves.

(2.) That *Tenderness* or softness (which is a quality very near of kin to sensibility) also is competent to it, is manifest to the Touch; and from hence, that if it were not easily alterable, by reason of its fine and delicate contexture, it could not so familiarly be affected by simple dryness, which is otherwise but a dull and sluggish quality.

(3.) *Mobility* also, *i. e.* flexibility and tensibility, is requisite to the same membrane, in some sort. For, the subtle motions of the tongue and palate, are sufficiently known from the very articulation of letters; those of the Gullet, from the deglutition of meat and drink; and those of the stomach, from its repletion, inanition, ructation, vomiting, *&c.* And this constitution of it also is hurt by dryness.

(4.) The *Permeability* or porosity of this membrane, is in the tongue, palate and throat very conspicuous, as well from the many little asperities every where discernable

nable in it, which adapt it to ſpew out into the mouth, the ſpittle which the *glandulæ ſublinguales* brings into them: as from this, that (like a ſponge) it imbibes and retains any moiſture put into the mouth. And in the ſtomach too the ſame poroſity is no leſs evident from the acid phlegm that is daily emitted from the arteries through this membrane, as it were by way of exſudation, into the cavity of the Ventricle.

(5.) *Cleanneſs* alſo is requiſite to the conſtitution of this membrane. For, in the ſtate of health, it is not polluted with any ſordid excrements or impurities, nor obſtructed with humors ſticking in the pores of it, nor diſcolour'd with any adventitious tincture, but alwayes neat and clean. And theſe are the five common qualifications required in the organ of Thirſt.

Of the three *Proper*, the *firſt* is a certain natural *Mador* or moderate moiſtneſs: for a perpetual ſupply of which Nature has placed in the mouth, ſix conſpicuous fountains, the two *ductus Salivales*, the two *Tonſills* or almonds, and two *rivulos catarrhales* bringing moiſture from the brain: and not thinking thoſe enough, ſhe hath ſuperadded innumerable *glanduloſæ Aſperities* in the tongue, palate and throat, which alſo with their dew contribute to the perpetual irrigation of this membrane. And therefore this may be reputed, the fundamental Conſtitution, in which the faculty of Thirſting is grounded, and upon which the two following are ſuperſtructed, as complemental additions.

The Second, *Proclivity to exſiccation*, if it be not ever now and then refreſht with moiſture. For the heat in the ſtomach and gullet, and the vicinity of the heart, contribute much to this arefaction: and in the mouth and throat, the drineſs of the air inſpired, and the heat of the breath expired, concurr to the ſame effect. But above all theſe cauſes, the deſcent of the Chyle, and

*Venæ*

*Venæ Lacteæ*, introduce drineſs upon the ſtomach, by exhauſting the liquors out of it, and conſequently by renewing the want of freſh drink, to ſupply the Univerſal *Latex ſeroſus*, which failing, the ſources of the *Glandulæ Salivales*, and other fountains of moiſture in the mouth, muſt ſoon be exhauſted. No wonder then, if the natural moiſture of this membrane, unleſs now and then recruited, be apt to fail, and arefaction ſoon ſucceed into the room of it.

The *third* and laſt, is a certain *impatience of drineſs*, without a querulous ſenſation of it. For, ſince this membrane ought, according to the inſtitute of nature, to be alwayes moiſtned; and yet notwithſtanding is, for the reaſons newly alleged, apt to be left deſtitute of its natural moiſture; and ſince it is, as I have already evinced, of acute ſenſe: it follows of neceſſity, that it can not but be ſenſible of, and impatiently tolerate drineſs, which is ſo repugnant to its natural conſtitution. And ſo at length have we attain'd to the knowledge of the reaſon of *Thirſt*, and of the manner of its *Senſation*. And as for the various *degrees* of it; they ariſe from the various degrees of exſiccation, and the ſhorter or longer continuation thereof.

Having thus found, both the formal reaſon, and the proxime cauſe of Thirſt; it follows, that we inquire into the *remote Cauſes* of the ſame. Theſe therefore may be all referr'd to ſix heads, whereof four are General or more remote, and the other two Particular and leſs remote. The *General* Cauſes are (1.) Too long abſtinence from drink, (2.) Immoderate heat of the body, and chiefly feveriſh diſtempers of the bloud, (3.) Defect of the general *Latex ſeroſus*, (4.) Diverſion of the ſame *Latex* from the organ of thirſt, to other parts. The *Particular* are (1.) Defect of the *Latex* in the Glands that ſerve particularly to ſupply the membrane

brane with moisture, and (2.) The depravation of the same *Latex* by qualities aliene from its natural constitution. Each of which causes I should particularly have explain'd, had I not consider'd, that a simple enumeration of them may be sufficient to the Learned part of my Auditors, and that I want time fully to explicate them to the rest. Trusting therefore in the memory of those, and the equity of these; I here conclude my jejune discourse of the second action of the Ventricle, *Thirst*; and following the clew of my method, pass to the *third*, viz.

## *The* PERISTALTIC *or* COMPRESSIVE MOTION *of the Stomach.*

III. The *PERISTALTIC* Motion of the Ventricle.

The appetites of hunger and thirst being satisfied, the Ventricle pleas'd with that relief, closely embraces the newly receiv'd meat and drink on all sides, spontaneously contracting it self into a narrower compass, and thereby lessning its cavity, so as to compress the contents: and this spontaneous contraction is therefore by *Galen* named in his language, κίνησις περισταλτικὴ, *motus compressivus circumquaque*; as the faculty or power by which the action is perform'd, is call'd Δύναμις περισταλτικὴ, *Facultas circum-constrictiva*. The same Faculty is well defined by *Gorrhæus* (a faithful Interpreter of *Galen*) in these words; *est quæ alimentum attractum arctè complectitur, quò meliùs concoquatur; ministra est virtutis retentricis, atque inde concoctricis.* But this definition, though convenient to the nature of the thing, so far as it extends, and to the notion *Galen* seems to have had of it: is notwithstanding too scanty to comprehend the *formal reason* of the Faculty, or to explain the *Manner* of its operation. Let us therefore seek farther, in hope at length to discover both.

To found this Periſtaltic Power in the ſtomach and gutts (for we are not now conſidering any other of the various cavities in the body, all which are alſo endowed with the like power) five things are of neceſſity requir'd, *viz.* (1.) A Cavity or receptacle, (2.) Matter contain'd in that Cavity, (3.) Tunics or membranes invironing the ſame, (4.) Fibres to gird or conſtringe thoſe membranes, (5.) Diſtinct orders, and different texture of thoſe fibres. For, in what part ſoever theſe five conſtitutions are concurrent, as they certainly are found in the Ventricle and gutts; that part hath a juſt and clear title to a Periſtaltic power, and may exerciſe it whenever occaſion requires. But the two laſt conſtitutions are thoſe in which the power is principally founded: the Fibres alone being the active cauſe of the compreſſive motion; and the different orders and texture of them, the cauſes of the differences of the ſame motion. Our buſineſs therefore muſt be, to inquire chiefly into the actions of the ſeveral orders of Fibres formerly deſcribed by us in the Tunics of the Ventricle, from the variation of which the various kinds of this compreſſive motion receive their diſtinction.

This Motion then is obſerved to be threefold, (1.) *Downward*, (2.) *Upward*, (3.) *Partly downward*, and *partly upward*: and the laſt ſort is ſubdivided into (1.) That which is perform'd with a certain *Luctation* or ſtrife, and (2.) That which is perform'd, not only without ſtrife, but with a kind of *ſport*. Beſides theſe differences, there are yet others ſubordinate to them. The Periſtaltic motion with ſtrife, is either *equal*, and then it may be call'd *Tonic* or *Æquilibrate*; or *unequal*, and then it is in the yielding fibres, *repreſſing* and *inverting*; in the prevailing, the Periſtaltic motion *inverted*. The *Sportive* motion is, from its uſe, call'd, the *diſtributive*

*butive* motion of the Chyle. Moreover all those different sorts of the Peristaltic motion have their various *degrees*, by which also they are remarkably discriminate among themselves: as being sometimes robust, sometimes languid; one while torpid and sluggish, another while vigorose and quick; sometimes placid and sedate, sometimes turbulent and tumultuous. And in handling all these, we are to consider the manner of the conspiracy and co-operation of three orders of fibres: beginning from the Peristaltic motion *downward*, which in the order of nature is præcedent to the motion upward; because the matter moved must first descend into the cavity of the stomach, before it can be therein agitated hither and thither. Not that this motion is to be understood to be *downward* in respect of the Centre of the Earth, but of the *ductus* or passage continued from the mouth to the fundament.

This Peristaltic motion *downwards* being sensibly perform'd in the swallowing down of meat and drink, in the descent of the Chyle, and exclusion of the excrements, is sufficiently demonstrated from those actions: and perform'd by virtue of all sorts of fibres.

*First*, By contraction of the *Transverse* fibres, which like Zones, making intire circles, must by shortning themselves, make less circles, and consequently by drawing the cavity they gird into a narrower compass, compress and squeez out the matter therein contain'd, upward or downward. Supposing then, that they begin their contraction from above, as about the upper orifice of the stomach; 'tis necessary they should depress or squeez down the matter contain'd in the cavity of it. For, the inferior fibres are supposed to be not yet vigorated or put into action, but to give way, and to suffer distention from the matter contain'd: and this very distention it is, that causes them to act by restoring

themſelves to their natural ſtate of moderate laxity. So that by this means the inferior fibres being ſucceſſively excited to perſue this motion from above downward, contract themſelves ſucceſſively, till they thruſt the matter contein'd quite out of the cavity that conteined it.

*Secondly*, Of the *Right* fibres, which alſo conſpire to this Periſtaltic motion downward. For, ſo ſoon as the Tranſverſe contract themſelves from above, they compreſs the Right contiguous to them, and thereby incite them to contract themſelves upward, by the ſpontaneous endeavor of reſtitution; ſo that they pulling the ſides of the cavity upward, cauſe it to forſake the matter contein'd, and by that means promote the deſcent of it. For in this caſe, it is all one, whether the matter contein'd be depreſs'd, or the cavity conteining be drawn upward from it. And this ſubduction of the cavity or *ductus* from the matter contein'd, anſwers ſucceſſively to every deſcendent contraction of the Right fibres, until the matter be brought thither, whither Nature ordein'd it ſhould be detruded. Wherefore this complex motion of Tranſverſe and Right fibres, may be not unfitly compared to motion of Earthworms crawling upon the ground. They take hold of the ſurface of the ground with their foreparts, which are to that end furniſh'd with little circular aſperities, and then ſhortning themſelves in the middle, draw up their hinder parts towards their foreparts, and ſo ſlide over the ground. Exactly ſo do the Right fibres withdraw the ſides of the *ductus* from the matter contein'd in it.

*Thirdly*, By the contraction of the *Oblique* fibres, which contribute their help too to this Periſtaltic motion downward. For, as they obtain a middle ſituation betwixt the Tranverſe and Right, ſo they perform a middle

middle Action: partly depreſſing the contein'd matter, partly drawing the ſides of the cavity upward; ſo co-operating with the Tranſverſe fibres, in the depreſſion of the matter, with the Right, in the retraction of the cavity. And in this manner all three orders of Fibres ſeem to concurr to the performance of the Periſtaltic motion *downward*.

To which the motion *Upwards* being contrary, and effected by the concurrent conſtriction of the very ſame fibres; the Manner of it muſt be contrary, *viz.* by *inverſion* of order. For, if the contraction of the *Tranſverſe* fibres begin from below, and proceed upward, they muſt preſs the matter that they gird, upward: and the *Right* at the ſame time put into action firſt from below, muſt draw down the ſides of the cavity from the matter therein contein'd, and conſequently help to impell it upward. And as for the *Oblique*; they, as in the former motion, partly aſſiſt the action of the Tranſverſe, and partly promove that of the Right. So that this Periſtaltic motion from below *upwards*, is (as I ſaid) coincident in all things with the motion from above downward, unleſs it be that the order of moving is inverted, and the terms of the motion contrary.

The two contrary Periſtaltic motions being thus explain'd, 'tis eaſie to comprehend the reaſon and manner of the *Mixt* motion, which is partly downward, partly upward; and belongs only to the ſtomach and gutts. Of this, the moſt acute Dr. *Gliſſon* hath obſerv'd three different ſpecies; two with *luctation*, and a third *delightſom*: all to be alſo aſcribed to the ſame three orders of Fibres (for, as ye may remember, there are no more) but moved in different manners, and more complexly. *Firſt*, If it happen, that fibres near in ſituation to, but ſufficiently diſtinct from each other,

ſuperiors

ſuperiors and inferiors, ſet upon the work of Periſtaltic motion together; and that ſome by compreſſion ſqueez the contain'd matter downward, others urge it upward: in this caſe, there muſt ariſe, in ſtead of a concurrence, a luctation or contention of the two mutually repugnant forces, and the Periſtaltic motion muſt be *Laborioſe*.

*Secondly*, That this *Luctation* may be determined to æquality, or inæquality, 'tis requiſite the forces or devoirs of the fibres contending, be æqual or unæqual accordingly. To equality of the forces, are requir'd on both ſides circular fibres ſhutting or cloſing the *ductus* or cavity. For, if the matter contein'd, ſhould freely ſlip away, the ſcope at which Nature aim'd, when ſhe inſtituted this motion, would certainly be fruſtrate, *viz.* the *Retention* of the aliment. Which great inconvenience ſhe foreſeeing, wiſely provided againſt it, by placing ſtrong circular fibres about each of the two Orifices of the ſtomach; which ſeems to be the reaſon, why in the ſtomach, and only in the ſtomach, this luctation is naturally found *Æqual*. I ſay, *naturally*; becauſe there may happen to be in the Gutts alſo the like Æquality, when they are obſtructed both above and below at the ſame time, ſo that the matter contain'd in the intermediate ſpace can not be propell'd either upward or downward: but this caſe is very rare, and præternatural. Notwithſtanding this æqual contention be peculiar to the two Orifices of the ſtomach, we are not to imagine it to be ſo conſtant, but that ſomewhat of the Chyle, during the act of Concoction, or part of the drink alſo, chiefly if it be ſpirituoſe, may now and then ſlip out through the *Pylorus*, being urged by the delightſome ſtrife of the fibres intermediate between the two orifices. We may therefore conclude, that this Periſtaltic motion proper to the ſtomach, is rooted, chiefly in

in the Annular fibres of its two Orifices, and partly in the fibres intermediate between them: and we may define the same to be *a close comprehension of the meat in the stomach, so æquilibrate, that the meat can neither slip thence either upward or downward præmaturely, nor remaining there fluctuate.*

But many times there happens as well in the stomach, as in the gutts, an *Unæqual* and *fluctuating* Peristaltic luctation; as may be inferr'd from slow and difficult Concoction, from wind pent in, from a laborious distribution of the Chyle, and many other Hypochondriac affects. And in this motion also, as in the former, the contending fibres are Antagonists, the superior striving on one part, the inferior on the other: those endevoring to thrust down the matter contein'd, these to impell it upward; but with *unæqual* forces: whence it comes, that the matter is agitated up and down by a kind of fluctuating motion: and therefore this Unæqual contention is rightly enough call'd a Peristaltic motion *Fluctuating*. Commonly it præcedes, and portends eructation, vomiting, præmature descent of the Chyle, torments of the Gutts, colic pains, fluxes of the belly, and the like symptoms, arising from offensive irritation of the fibres of the stomach and gutts. The fibres concern'd in this turbulent motion, may be divided into two parties, the *Prævailing*, and the *Yielding*. The *Prævailing* fibres do, not only suppress, but also *invert* the Peristaltic motion of the yielding; yea more, they persue their victory, till either other fibres rise up and repell the force of the former, or they themselves, the irritation by little and little ceasing, become quiet of their own accord. To explain this by an Example; in the *fluctuation* of the stomach, if the Peristaltic motion begin about the upper orifice, it proceeds thence to the fibrose neck of the lower,

lower, and is there, by reason of the strength of those fibres, repress'd and inverted: then the motion ascends by degrees to the upper orifice, where it is again repress'd and inverted downward; nor doth the fluctuation cease, till the wind be by belching discharged, or the cause of the irritation, whatsoever it be, expell'd, whereupon the contending fibres are appeas'd, and the warre comes to an end. In like manner, if in the gutt *Ileum* the Peristaltic motion begin about the *Colon*, and drives the matter contein'd in the *Ileon* upward; the motion is hardly repress'd, till part of the matter be brought up to the fibrose neck of the *Pylorus*; and then it is not only stopp'd, but inverted. The same may be conceived to happen in the *Colon & intestinum Rectum*, in which the two terms of the motion are the *Valve* of the *Colon*, and the *Sphincter* of the fundament.

The *Third* and last kind of the Mixt Peristaltic motion, is that which *distributes* the Chyle, and which is rather placid and grateful to both stomach and gutts, than tumultuous or offensive. The manner of this subtile and complex motion may be conceiv'd from an inspection of the gutts of an Animal newly kill'd, and opened while some reliques of the vital heat are yet remaining in them. For one shall see the Gutts variously shortning, wrigling and wresting themselves, like a heap of Earthworms crawling some over others, and striving as it were to creep upward and downward by turns; but without a directing faculty. Now the *use* of this admirable motion is double, *viz.* (1.) An *equal distribution of the Chyle* and other matters contein'd in the stomach and gutts, (2.) The *Agitation of the Chyle it self.* For, all things admitted into the stomach and gutts, require an equal distribution in them; but the Chyle requires also a peculiar agitation, that it may be in all parts of the gutts brought home

home to the very mouths of the *Venæ Lacteæ*.

Finally, as for the *Gradual Differences* of the Peristaltic motion; they are either *simple* or *complex*. The *Simple* arise from the strength, irritability, and actual irritation of the three orders of fibres; and therefore cannot exceed the number of three. For, from the *strength* of the fibres, the Peristaltic motion is said to be strong, moderate, or weak: from the various degrees of their *irritability*, it is named quick, moderate, or sluggish: from the greater or less actual *irritation*, it is call'd tumultuous, moderate, or sedate. The *Complex* proceed from the various combinations of the Simple, and therefore may be collected from our præcedent descriptions of the same. Let this therefore suffice concerning the Peristaltic motion of the Ventricle and gutts; and let us progress to that which many excellent Men, in imitation of *Galen*, have call'd, the *Attractive Faculty* of the Stomach. ¶.

IV. The *RECEPTIVE* power of the Ventricle.

In hunting after Verity in the works of Nature, they are of all men most liable to error, who neglecting the use of their own sagacity, and shutting the eye of reason, follow the cry of *Autority*, and run on in the tract of their Leaders, without stopping to examine whether it be right or not. Of this, we here are fall'n upon a remarkable example. For, some *Anatomists*, neither few in number, nor of obscure name, blindly adhæring to the opinion of their Predecessors, as Geese go in a file to the water, have rashly ascribed to the stomach, I know not what *Attractive Faculty*, by which they imagined the meat and drink to be drawn into it, as iron is by the Vulgar believ'd to be drawn by a Loadstone: placing this power (forsooth) in the *Right* fibres thereof; than which it is not easie to

find a groſſer abſurdity. For, this ſuppoſed Power is neither neceſſary, nor probable.

(1.) *Not neceſſary*; becauſe all meat and drink is brought into the ſtomach by Deglutition or ſwallowing alone; and that action is performed (as we have formerly demonſtrated) not by way of Attraction, but depreſſion and protruſion. What need is there then of Attraction to do the ſame work? or is it the cuſtome of Nature to multiply faculties to no purpoſe?

(2.) *Not Probable*; becauſe perhaps there is really no ſuch thing in nature as *Attraction*; all motions thereto aſcribed, being more truly referrible to ſimple *impulſe*. And if there were, the Attraction here imagined, muſt be either Similar, or Organic. But that there is no *Similar* Attraction in the caſe, is manifeſt even from this; that Similar Attraction ſuppoſes a certain congregation or ſpontaneous concurſe of things like to their like: but betwixt the meat and the ſtomach is, neither ſpontaneous coition, nor ſimilitude; nay, ſomtimes it happens, that by deglutition are brought into the ſtomach things highly ungrateful, and unlike to it, as purging medicaments. Whence we may ſafely conclude, that the admiſſion of things into the Ventricle is not perform'd by virtue of Attraction Similar, but only of ſwallowing.

And as for Attraction *Organic*; here are no inſtruments fit to effect it. Theſe Authors indeed are pleas'd to affirm, that the Right fibres draw down the meat: but they have omitted to ſhew *how*. Have theſe fibres hooks to take hold of every bit of meat that comes into the mouth? can they, like chords, pull it down? Should theſe *Litterati* ſeek refuge in the old Peripateric dream of attraction *ob fugam vacui*, they could not defend this their opinion: (1.) Becauſe that fantaſtic Sanctua-

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ry hath long since been demolish'd; (2.) Because the Stomach can not possibly form any such cavity, as is requisite to introduce a competent vacuity. For, if it contract its fibres on all sides, it must of necessity diminish its cavity: and if it relax them, the sides of it instantly flagging, come together: in both postures excluding vacuity. In fine therefore, seeing this Attractive Faculty ascribed to the Ventricle, is neither necessary, nor explicable either by the hypothesis of Similar attraction, or by mechanic principles, or by the Aristotelean supposition of Natures abhorrence from vacuity: what remains to support it? Certainly nothing, but the credulity of those servil spirits, who choose rather to err with their Teachers, than to recede from them; as if Philosophical doctrines were, like the principles of Religion, not to be examined, but implicitely believ'd. Let us then wholly expunge this Attractive power out of the list of Faculties belonging to the Stomach, not only as fictitious, but absurd also and impossible.

This was well understood by our incomparable Dr. *Glisson*, who thereupon endevor'd, instead of this imaginary faculty of attraction, to substitute another less improbable, which he call'd the *Receptive* faculty of the Ventricle; defining it to be, a certain aptitude of the stomach, by which it relaxes its fibres, and inlarges its cavity, to receive meat and drink brought into it, without reluctation: and the *Reason* that induced him so to do, is this; that whenever the stomach dislikes the thing to be swallow'd, the act of deglutition is perform'd with difficulty, and accompanied with nauseousness and great aversation: but on the contrary, things grateful to the stomach, though bitter perhaps and unpleasant to the Taste, are yet easily swallow'd, and receiv'd by the stomach with complaisance and delight.

Nevertheleſs, ſuch (I acknowledge) is the dulneſs of my brain, that I do not yet comprehend the neceſſity of this ſubſtitution. For, although the ſtomach be, by reaſon of its cavity, apt to receive meat and drink; it does not neceſſarily follow, that therefore this Aptitude deſerves the name of a *Faculty*: unleſs ye ſhall judge it reaſonable for a man to ſay, that becauſe a ſack is capable to be fill'd with corn, and a bladder with liquor or wind, therefore they have a *Receptive Faculty*. A Faculty (ye know) implies an Action; but the Receptive faculty here ſpoken of, ſeems to me to be a mere *Paſſion*. Is it not manifeſt even to ſenſe, that the ſtomach is alwayes more or leſs diſtended, in proportion to the quantity of nouriſhment brought into it? and whence comes that diſtenſion? certainly not from ſpontaneous relaxation of the fibres of the ſtomach, but on the contrary, from their forced extenſion by the weight and bulk of the meat and drink admitted. For, no *Tenſile* body whatſoever can extend it ſelf, becauſe extenſion is an endevor and degree toward the ſolution of its continuity, and therefore repugnant to its nature; and no natural Agent can act towards its own deſtruction. The proper and ſole action of all fibres, is ſpontaneous *Contraction*, whereby they reſtore themſelves to their native poſture and quiet, ſo ſoon as the ſtretching they ſuffer'd, ceaſes. How then the fibres of the ſtomach ſhould come to be able to ſtretch themſelves in length, I do not underſtand. And as for the difficult ſwallowing of things which the ſtomach abhorrs, and the nauſeouſneſs accompanying it; why may not that be referr'd to the præjudice of the *Imagination* conſequent to the perception of their ungrateful ſmell or taſte? the rather, becauſe when Reaſon hath maſter'd that præjudice, as it alwayes doth in men taking vomits, purges, and other ungrateful medicaments,

ments, even the most unpleasant things are without difficulty admitted into the stomach. So is Wine also in excessive quantity pour'd in by Drunkards, notwithstanding the reluctancy of the stomach. So that it is not constant, that the stomach hath a *Receptive* Faculty, whereby it is empower'd to admit what it likes, and to reject what it dislikes, as this Paradox supposes it to have. This I have taken liberty to say, not from a petulant itch of contradiction, not from vain ambition to have the glory of contending with so great a Champion, but merely from the uncertainty of my judgement: which induced me to set before you the arguments for and against this opinion of a Receptive faculty in the stomach, to the end that I might learn from you, which are the more weighty. Leaving this nice quæstion then to your decision, I proceed to the fifth action, or,

V. *RETENTIVE* faculty of the Stomach.

*RETENTIVE FACULTY of the Stomach,*

Which is highly necessary to *Nutrition*. For, the transmutation of the newly receiv'd meat and drink into Chyle, being not perform'd in a moment, but a work of some hours; unless they be retein'd in the stomach a competent time, till that work be finisht, both the *Concoction*, and the immediately following *Distribution* of the Chyle, without which there can be no Nutrition, must be imperfect.

This Retentive power seems to me to be wholly *Organic*, and to consist, partly in a moderate and gentle Contraction of all the fibres of the Stomach, but chiefly of those that close the two Orifices of it; partly in a due Asperity of the inmost Tunic of the same.

(1.) In a *moderate Contraction of all the fibres*; because otherwise the stomach could not closely embrace the

the food while it is concocted, which requires a *Tonic* motion of all the fibres, and such a one too, as renders their forces in a manner *equal*, in all parts of the stomach; except the two orifices, where the constriction is stronger and closer, and chiefly in the *superior*, which during the whole action of Concoction remains closed even to a point. And this Contraction must be *moderate* and gentle, because all violent and impetuose Contraction, either causeth expulsion, or at least makes the retention tumultuose and inordinate; both which equally frustrate the design of Nature in the work of Chylification. During which the Ring of the *Pylorus* is not so closely shut, but that it gives way to *liquids* to slide down now and then into the gutts; though at the same time it strictly retains whatsoever is *solid*, and not yet converted into Chyle, that it may be farther digested. Nor doth it seem necessary, that *liquids* should undergo any farther concoction, being in that form fit to be admitted into the *Venæ Lacteæ*; whereas Solids are not fit, till they have been melted. Which seems to be the reason, why those who drink the *Spa*, *Tunbridge*, and other the like subacid *mineral* waters, stay not expecting any concoction of them, but piss them out in a short time after, just such as they drank them. So do Good Fellows for the most part render their wine by urine, almost as fast as they pour it into their stomachs, at least much sooner than it can be digested. And all know, that Wine is no sooner received into the stomach, but in a moment it enters into the veins, cheers the heart (as they say) and recruits the spirits, rendring the pulses stronger than before. From all which instances we may collect, that *liquids*, chiefly such as are full of *spirits*, stay not long in the stomach, but soon slip through the *Pylorus* into the gutts, and insinuate themselves into the *Venæ Lacteæ*, leaving the grosser

groſſer and ſolid parts of the food behind, to receive farther elaboration.

(2.) In a due *Aſperity of the inmoſt membrane of the ſtomach.* For, as lubricity and ſmoothneſs of any ſurface favors the ſlipping away of bodies touching it: ſo doth the *Roughneſs* conduce to their adhæſion. And all *Aſtringent* remedies, unleſs they ſome way or other induce a loathing or nauſeouſneſs upon the ſtomach, as they cauſe a contraction of the fibres, ſo do they corroborate the Retentive faculty of the ſtomach: whereas on the contrary, all *Lubricantia* conduce more to Expulſion, than to Retention. Again, in the *Lienteria* there is alwayes too great a *ſlipperineſs* of the ſtomach and gutts: as too great an *Aſperity* in *Coſtiveneſs*. Finally, crude or raw food hath alwayes in it ſomwhat of aſperity; but being præpared by fire, becomes more ſoft, tender and ſlippery. Which may be the reaſon, why raw meats generally are more eaſily retain'd in the ſtomach, and ſuch as are throughly boil'd, baked, or roaſted, are more eaſily expell'd: thoſe inducing roughneſs, theſe ſmoothneſs upon the parts of the ſtomach they touch. So that from all theſe inſtances it may be inferred, that to the Retentive power of the ſtomach, a certain Aſperity in the ſurface of the inmoſt coat thereof is requir'd.

To theſe two Organical Conſtitutions of the ſtomach, in which it is apparent, that the Retentive power thereof is founded, ſome have added a *third*, not Organic, but *Similar*, and conſiſting in a certain *Complacency* or delight, which the fibres receive from the præſence and contact of the meat and drink. But this opinion being grounded wholly upon the Hypotheſis of *Natural Perception*, which yet ſeems obſcure, intangled with various difficulties, and therefore doubtful; I ſuſpend my aſſent thereunto, till I ſhall have

learn'd

learn'd from you, whether I ought to embrace, or reject it. Meanwhile I take liberty so far to justifie this my suspence, as to allege a reason or two in defence of it.

That not only the stomach, but all other sensile parts of the body are, from the very first moment of their formation, naturally endowed with a certain power, by which they distinguish what is grateful and profitable, from what is ungrateful and noxious; and which is the cause of all those motions and actions by Physicians generally and truly ascribed to irritation; is most certain, and to all men that consider Human nature, evident even from these arguments following.

(1.) In an egg, the very *Vesicula pulsans*, before it is formed into a heart, and a day or two before any the least rudiment of brain or nerve can be discerned; if it be, though never so gently, toucht with the point of a needle, doth instantly contract, and (like the sensitive plant) shrink in it self, as *feeling* the hurt done to it.

(2.) And the first modell or draught of the Embryon, while it appears to be a mere mucilage or gelly, before there is any distinction of members, and when the brain is yet nothing but clear water; if it be in any part likewise prickt, contracts, and wreaths it self, like a maggot or caterpiller: demonstrating to the eye of the Spectator, that it feels the puncture, and endevors to avoid it.

(3.) After the whole work of Formation hath been consummated, from the hour of our nativity to that of our death, there are performed within us many secret motions and actions, which are by Physicians (for distinction sake) call'd *Natural*, because they are done, not only without our knowledge or direction, but even against our will; so that we cannot moderate, accelerate, retard, or inhibite them, as being

being independent upon the regimen of the Brain: and yet notwithstanding this independency, they must proceed from some kind of Sensation, by which the parts wherein they are done, are incited, irritated and altered. For instance; in the Heart it self there often happens great disorder of its motions, causing palpitations, tremblings, convulsions, faintings, swounings, and various alterations of the Pulse, in magnitude, celerity, rhythm, *&c.* and all from some morbifick matter offending the fibres, and hurting their natural sense. For, whatsoever by its own motions endevors to deliver it self from offences and harms, must certainly be endowed with a power to perceive or feel them.

Nor is the skin it self destitute of this distinct faculty. For, Experience convinceth us, that it easily distinguishes a venenate or poysonous prick, from a simple one; and thereupon constringeth it self, and becomes more dense, so that an inflammation and burning Tumor arises from thence; as may be observ'd in the invisible punctures made by the sting of a Wasp, the tooth of a Spider, or the proboscis of a Gnat. To be the more ascertain'd of this, our most sagacious Dr. *Harvy* made a pretty experiment upon himself, and hath left it upon record in 56. *exercitat.* of his incomparable Book *de Generat. Animal.* "I prick'd my "hand with a needle, saith he; and soon after rubbing "the same needle against the tooth of a Spider, I "thrust the point of it into my hand in another place: "nor could I perceive any thing of difference betwixt "the two little punctures. But in the skin it self there "was somwhat that discerned betwixt them. For, in "the place where the venenate prick had been made, "the skin soon contracted it self into a little hard "tumor, accompanied with redness, great heat, in-"flammation, and acute pain; as if it fortified it self

"againſt the invading enemy, and ſtrove to ex-
"pugne it.

To come to the ſtomach, our præſent ſubject; this part alſo, and the gutts, being offended and provok'd by ill humors, often raiſe great commotions, nauſeouſneſs, belching, vomiting and fluxes of the belly: and as it is not in our power, at pleaſure either to ſuppreſs, or to promote thoſe diſorders; ſo neither do we know any ſenſe depending upon the brain, that can exſtimulate thoſe parts to ſuch violent and tumultuous actions. 'Tis wonderful even to a Philoſopher, that a little of the infuſion of *Crocus Metallorum* ſhould produce ſuch ſtrange commotions in the ſtomach. We can not diſtinguiſh that infuſion, from good Sack, by the taſte; nor perceive any trouble or offence in ſwallowing it: and yet there is in the ſtomach a certain ſenſe that ſoon diſcerns the Antimony from the Wine, that abhorrs it, and incites the ſtomach with all its forces to eject it by vomiting. Hence alſo it is perhaps, that Alum, Vitriol, Salt of Vitriol, and (ſometimes) Salt of Steel; though by their aſtriction they augment the aſperity of the inmoſt membrane, and the contraction of the fibres of the ſtomach (which are the two Organical Conſtitutions, in which the Retentive power of it is, according to my opinion, wholly founded:) are obſerved notwithſtanding commonly to excite vomiting; and this only, becauſe they have ſomwhat in them that is highly ingrate and offenſive to the natural ſenſe of the ſtomach.

Now from theſe Arguments and particular inſtances (to omit others of the like importance in other ſenſile parts of the body) it ſeems moſt evident, that there is in us a certain ſenſe of Touching, that cannot be referr'd to the *common ſenſe*, nor belong to the juriſdiction of the *brain*; and therefore is rightly diſtinguiſhed

guiſhed from the *Animal* ſenſe of Touching. Such a ſenſe we obſerve in *Zoophytes* or Plant-animals, the Senſitive plant, ſponges, and the like. And as Phyſicians teach, that *Natural actions* differ from *Animal*: ſo with equal reaſon may we ſay, that this *Natural ſenſe* of *Touching*, whereof we are not conſcious; differs from the *Animal* ſenſe of Touching, whereof we alwayes are conſcious; and that it conſtitutes a diſtinct ſpecies of *Touching*.

This, manifeſt from its effects, but perplexingly obſcure in its origin and eſſence, *Campanella* (who wrote large and moſt ſubtile Commentaries concerning it, now almoſt neglected) and our Excellent Dr. *Harvy* call'd by the name of *Tactus Naturalis*: but their Equal, Dr. *Gliſſon*, coming after to conſider the thing more Metaphyſically, and founding the very life or ſubſtantial Energie of Nature wholly upon the ſame, denominated it *Perceptio Naturalis*, thereby to diſtinguiſh it from all the Senſes, as well internal, as external; from which he will have it to be really different, as for many other Reaſons (alleged *in cap.* 15. *lib. de Vita Naturæ*) ſo chiefly for this; that it is not immediately communicated to the Brain, or Common Senſory, as Nature hath inſtituted that all Senſations of the Organs of the External Senſes ſhould be communicated, before the act of Senſe can be complete; though the ſame Natural Perception may be, and often is, by various degrees, changed into Senſe.

Now therefore, that I may draw all the lines of this Digreſſion quite home to the Centre of my præſent ſcope; that there is ſuch a thing as Natural Feeling or Perception, I acknowledge: that the name of Natural Perception is more diſtinctive, and therefore more proper, I confeſs: I grant alſo, that this diſcerning faculty is, by the immenſe bounty of the Omnipotent Creator,

conferr'd upon all the ſenſile parts of the body, and among theſe upon the ſtomach in a high degree: I farther grant, that by virtue of the ſame, the Retentive Faculty of the Stomach may be, in ſome caſes, much aided and promoved: All theſe things I hold my ſelf obliged to concede. What then remains to be the ſubject of my doubting and ſuſpenſe? Two things there are, which yet I can not bring my weak reaſon to admit, though they have been, and with ſtrong arguments too, aſſerted expreſly by a Man, whoſe doctrin I often follow, and whoſe autority I venerate.

The *Firſt* is, that not only the ſenſile parts of Animals, but this inanimate, yea, every ſingle particle of Matter in the Univerſe, is from the Creation, endowed with this faculty of *Natural Senſe*, or *Perception*, (call it what ye pleaſe) and with its inſeparable Adjuncts, natural *Appetite* and *Motion*. For, who can believe, that any part of this dead body hath a perception of the knife of the Diſſector, and that the fibres of the fleſh ſuffer as much of irritation from the ſolution of their continuity now, as when the body was animated by a ſoul, and they were invigorated by the heat of the arterial bloud, and the influence of the vital ſpirits? Who can be perſuaded, that a marble pillar, when knock'd with a mallet, feels as much pain, as the limbs of an Animal, that is beaten with a cudgel? And yet both theſe things muſt be true, if the ſuppoſition of Natural Senſe or Perception be ſo. What then ſhall I do to extricate my thoughts from the perplexing difficulties of this Ænigmatic Paradox? My Curioſity urges me to examine them, my Underſtanding is unable to ſolve them, and the Theorem is moſt noble in it ſelf. Wherefore my deſire of Knowledge will be alone ſufficient to excuſe me, if deſpairing of ſatisfaction from my

my self, I humbly seek it from the Oracle of your more discerning judgement.

The *Other* (more neerly touching the point in quæstion) is this. I do not perceive any necessity, why *Natural Perception* should be brought in to concurre with the two newly explain'd Organical Constitutions of the Stomach, in which the *Retentive Faculty* thereof seems to me to be wholly founded. For (1) that placid quiet which the Stomach is observ'd to enjoy, when satiated with good and wholsom food, may arise only from the cessation of the anxiety and trouble it suffer'd from the vellication or gnawing of Hunger; the biting Acidity of the *Fermentum Esurinum* being now blunted by the benign juice of the Aliment newly receiv'd. After which, the fibres, that before were irritated, gently and placidly restore themselves to their natural posture (as all other *Tensil* bodies also do) and therein attain to quiet and ease. So that the *Complacency* of which the stomach is then sensible, seems referrible to the *Sense* of *Touching*, common to all sensile parts of the body. For, if *Hunger* be an ungrateful *Sense* of emptinēss or want of food; why should not *Satiety* be a grateful *sensation* of the supply of that want? since contraries are ever comprehended *sub eodem genere*. (2) But were the Complacency transferr'd from Sense to Natural Perception, yet would it not be necessarily consequent, that therefore the same is required to consummate the Retentive faculty, because usually the meat is retain'd in the stomach a good while, some hours, after the complacency ceaseth; and therefore the Retention seems, not to depend upon it. And this may be confirm'd from hence, that it is observed, that by how much more delicate and grateful to the stomach the meat receiv'd is, by so much the less while it is therein retain'd. Now these are the reasons that withhold me from

from assenting to that opinion, which placeth the Retentive power of the stomach, chiefly in the Natural Perception of it. But whether they be of weight enough to justifie my suspense, or not; I leave to your determination; and here turn over leaf to a new lesson, *viz.*

## *The* CONCOCTIVE *Faculty of the Ventricle.*

VI. The *CONCOCTIVE* Faculty of the Stomach.

*WHICH*, according to the order of Nature, is next to be consider'd; for all food is swallow'd, receiv'd, and then retain'd by the stomach, in order to its *concoction* or conversion into Chyle.

That this operation is, not organic (as we have shewn all the præcedent to be) but wholly *Similar*, is sufficiently evident from hence; that the Chyle it self, when confected, is similar; and all the Actions, by which it is made Chyle, are so too: nor dos the Cavity of the Stomach contribute more to this work, than a pot doth to the boyling of the flesh, that is put in it over the fire.

Most true it is nevertheless, that the Organ in which the work of Chylification is perform'd, is principally the *Ventricle*, in which the Concoctive power is most vigorose, and to which Nature hath committed the most difficult part of the whole operation. I say *Principally the Ventricle*; because I would not wholly deprive the *Gutts* of their right to the like power of changing aliments into Chyle, though they do it less efficaciously than the stomach, and as it were at second hand; that is, if any part of the Chyle happen to descend into them not perfectly elaborate, they farther concoct it, finishing the work the stomach had begun. Hence it is worthy our observation, that the Chyle taken in by *Venæ Lacteæ* immediately from the stomach,

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is thinner and more ſpirituoſe, than that imbibed from the Gutts; and that receiv'd from the ſuperior Gutts, thinner than that exported out of the inferior; and in fine, the thickeſt is convey'd out of the *Colon*, and *inteſtinum rectum*. So that we may conclude, the ſtomach is the *primary* ſeat or place of Chylification, and the Gutts, the *ſecondary*.

Having thus eaſily found, what kind of operation the converſion of meat and drink into Chyle, is; and where it is performed: we are in the next place diligently to inquire (1.) What are the capital Differences of Aliments to be concocted in the ſtomach; (2.) What various Mutations or Alterations the food ought to undergo, before it can be brought to the requiſite perfection of Chyle; and (3.) What are the Cauſes, by which thoſe Mutations are effected. And theſe are the three general heads of this our diſquiſition.

As for the *FIRST*, *viz.* the differences of Aliments to be digeſted; 'tis well known, that all our food is either *Meat* or *Drink*, *ſolid*, or *liquid*; and all our drink, either *ſpirituoſe*, or *watery*.

That all *Potulent* liquors require leſs coction in the ſtomach, than ſolid meats, is not to be doubted; becauſe they ſerve rather to dilute the thicker aliments, and give them a conſiſtence requiſite to their converſion into Chyle, than to nouriſhment: and becauſe daily Experience teaches, that by how much the thinner and more penetrating, or diuretic they are, by ſo much the ſooner they paſs by urine, without any notable alteration; as we have already declared of the *Spa* and *Tunbridge* waters: and *ſpirituoſe* or *vinoſe* drinks, (*cæteris paribus*) are ſooner digeſted, than ſuch as are not vinoſe; yea more, they are juſtly preferr'd for their virtue to promove and accelerate the digeſtion

digeſtion of other things. The reaſon of which perhaps is, as well becauſe their ſpirits augment the influent heat of the ſtomach, as becauſe they ſoon grow acid, and ſo quicken the activity of the diſſolving ferment therein contain'd. For, moſt certain it is, that all wines turn acid, almoſt as ſoon as they are receiv'd into the ſtomach; becauſe by the Fermentation therein made, their ſweet and more fugitive ſpirits are diſpers'd in a trice: and thoſe being gone, the reliques ſoon grow ſowre, from the operation of the acid ferment upon them; and by that newly acquir'd ſharpneſs, further concoction.

*Liquid* or ſpoon-meats alſo, as pottages, milk and the like, are ſooner and more eaſily digeſted, than ſolid: becauſe their nutritive parts being actually diſſolv'd afore-hand, they require only a light elevation of their ſpirits, by the fermentation of the ſtomach, to make them perfect Chyle, and fit to be admitted into the *Venæ Lacteæ*. Provided, that if they be of a thick conſiſtence, as pap, barly cream, frumentry, gellies, butter'd eggs, and ſuch like, they be firſt diluted with drink, that they may more eaſily paſs into the milky veins.

*Solid* meats are, as of greateſt nouriſhment, ſo moſt difficult of digeſtion. For, they muſt paſs through all the various Alterations requiſite to the concoction of any Aliment whatſoever, before they can be brought to the ſtate of perfect Chyle. While they remain in a ſolid form, 'tis impoſſible for them to enter into the inconſpicuous mouths of the *Venæ Lacteæ*: and therefore it is neceſſary, they ſhould be melted, and reduced into the form of liquor, at leaſt that the tincture drawn from them may be ſuch, before they be offer'd to them. ¶.

Now

Now those various *ALTERATIONS* requisite to the perfect concoction of solid meats, are (besides those that are common also to liquids) but two, *viz. Liquation*, and *Extraction of Tincture*.

By the *first*, they are dissolved into a kind of Gelly or Mucilage. For, bread is by digestion turn'd into a papp, and the softer parts of flesh into a gelly or Consummé. The harder parts of neither are wholly dissolv'd, but for the most part commixt with the Excrements of the belly, voided whole. Hence it is, that experienc'd Nurses judge of the good or bad concoction of Infants, from inspection of their stools. For, if they therein discern any reliques of flesh undissolv'd, they truly conclude from thence, that their digestion is imperfect, and that food of easier concoction is more convenient to their weak stomachs, and accordingly abstain from giving them flesh, till they are more able to digest it.

By the *other*, the Tincture of solid meats is extracted: and this Alteration is competent to such tough and stubborn meats, as refuse to be dissolved. Some things indeed are now and then swallow'd down, that by reason of their hardness, are incapable either of dissolution, or of yielding any tincture; such as Cherry-stones, the kernells of grapes or raisins, *&c.* but these deserve not to be reckon'd among Aliments, nature alwayes rejecting them whole and unchanged, among the Excrements. And these are the two requisite Alterations proper to solid meats: besides which, there remain yet three others *common* to both solid and liquid. Of these

The *First* is *Dilution* or through-mixtion of them with the drink; without which even liquids themselves, if of a consistence tending to thickness, could

never be tranſmitted into the *Venæ Lacteæ*. To this Dilution of ſolids is requir'd, at firſt a ſmall quantity of liquor: becauſe a large draught in the beginning of a meal, doth diſſolve, not the whole ſubſtance of the meat, but only the more tender and thinner parts of it, and extract them by way of tincture, leaving the reſt untouch't. But after the ſubſtance of the meat hath been eliquated into a gelly, a larger proportion of drink is requiſite to give it a thinner conſiſtence. On the contrary, to the Extraction of a tincture, a copious Menſtruum (as Chymiſts well obſerve) is requir'd. Which our skilful Farriers and Grooms having from experience learn'd, keep their Horſes from water for an hour or two after they have eaten their oats. 'Tis therefore a good rule for conſervation of health, to drink ſparingly in the beginning of a repaſt; and freely toward the end of it, when the meat hath been diſſolved, and requires to be farther diluted.

The *ſecond* is, an *Exaltation of the ſpirits* of the meat to the degree, not of Volatility, but *Fuſion*, that they may be more eaſily admitted into the *Venæ Lacteæ*, and paſſing thence into the bloud, ſerve to recruit the vital ſpirits. For, the proper office of the ſtomach is, to make of the food a permanent liquor, not fugitive vapors, that would inflate and torment it: and that permanent liquor ought to be replete with gentle ſpirits, that the vital ſpirits, which are continually diſſipated and conſumed, may be from thence ſupplied. Whence we may collect what the reaſon is, that Wine and all vinoſe drinks do leſs require this alteration, than other liquors, *viz.* becauſe their ſpirits are in the ſtate of fuſion before they are admitted into the ſtomach, and ſo need but little farther elevation.

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The *third* and last Alteration common to both solids and liquids, is an *Assimilation* in some measure of the nourishment to the nature of the body to be thereby nourished; at least a bringing of it nearer to the constitution of the body. For, by how much the more of similitude is betwixt two bodies, so much the more easily is the one transmuted into the other. Of this Assimilation are two parts; of which, one takes away the qualities of the food that made it unlike to the constitution of the body assimilant; the other introduces new qualities more agreeable and conform to it. The *first* is *destructive* of the old form; the second *eductive* of a new one. The destructive part consists in, first a gradual debilitation, and then a total subduing or taming of the reliques of the former seminal impressions of the aliments: in all which there certainly remain some *vestigia* or prints as it were of their pristine form, which may properly enough be call'd their *seminal impressions:* and these are to be at least so far subjugated, as to leave the matter capable of, and disposed to admit new specific impressions. Not that it is necessary they should be utterly *abolished* or eradicated, which perhaps is more than either the acid ferment, or heat of the stomach, or both together can do. For, in all Aliments, Vegetables or Animals, there are Ἀνεπιδεια, ἀκρησια καὶ ἰσχυα (as *Hippocrates de prisca Medicina*, calls them) certain indelible characters, or insuperable qualities, that may be as it were tamed or kept under, but can never be totally destroy'd. Our meat indeed is cookt by fire, broken into small pieces by our teeth, softned by the *liquor salivalis*, boyl'd in the stomach, melted by the acid ferment, exagitated by the peristaltic motion of the gutts, and therein farther elaborated, and separated from its dreggs, squeez'd into the milky veins, thence transmitted into

the common receptacle, thence propell'd by the Chyliferous pipes into the ſubclavian veins, and ſo mixt with the bloud, exagitated again by the motions of the heart, and impragnated with vitality by the powerful energy of the vital ſpirits; all theſe alterations, I ſay, it doth undergo, and yet notwithſtanding it ſtill reteins much of thoſe invincible reliques of its former nature, which the *Chymiſts* have named, *mediæ vitæ characteres*, and others, *Seminales impreſſiones*. And hence it is, *quòd omnia animalia ſapiant alimenta quibus veſcuntur*, All Animals, however præpared or cook't, ſtill retain ſome ſavor, ſome ragouſt of their uſual food: as Birds that live upon little fiſhes, yield a fiſhy Haut-gouſt; and the fleſh of Swine fed with Sea-Onions, is apt to cauſe vomiting in the Eaters of it, *&c.* Wherefore by this laſt act of Concoction, we are to underſtand only ſuch a change of the Aliment, as renders it more familiar and aſſimilable to the nature of the parts of the body therewith to be nouriſhed: for, a *perfect Aſſimilation* is not to be expected, till the ſame ſhall be intimately united with them. Nor is Chylification, what many have conceiv'd it to be, an abſolute *Metamorphoſis* of the Aliment, or corruption of its firſt form, and change of it into a new ſpecies; there ſeeming to be no ſuch thing as *Corruption* in the caſe, but an *Exaltation* rather, or *Melioration* of the nature of the food, by advancing it from the ſtate of fixation, to that of *Fuſion*, that it may be prædiſpoſed to its ſucceeding converſion into bloud and the *Succus Nutritius*. True it is indeed, that the meat is ſomtimes corrupted in the ſtomach, by vitious humors therein contein'd and depraving it, and by various other cauſes: but it doth not from thence follow, that abſolute Corruption is neceſſary to the præparation of the Chyle; but rather that the meat, if by accident it be abſolutely

absolutely corrupted in the stomach, is thereby render'd unprofitable to nutrition for the most part. True it is also, that the dreggs of the Chyle, being by way of *Degradation* from their former nature, changed into *Excrements*, put on a new form in the *Colic* Gutt, and differ *in specie* from that part of the meat out of which they are made: and yet notwithstanding, we can not from thence rightly inferr, that the *Chyle*, which is by a perfective motion gradually meliorated, is necessarily changed also into a new species, before it can actually nourish.

Is no part of the Aliment then, in the act of Chylification, metamorphosed from one species to another? I conceive *not*; unless the Version of the *Acidum Vegetabile in Salsum Animale*, be accounted a Specific Mutation. If so, then this must be excepted from the general rule. For, certain it is, and acknowledged even by Chymists themselves, that *Vegetable Salt*, such as is usually extracted from Plants, is no where to be found in the bodies of Animals; neither in their bloud, nor in urine, nor in flesh, nor in bones, hairs, nails, *&c.* and therefore very probable, that every *Acidum Vegetabile* is transmuted *in Salsum Animale*, either in the stomach, or in the descent of the Chyle into the Gutts, or soon after. Nor is it (in my poor judgement at least) a thing of small moment, or lightly to be regarded, that all parts of all Animals, are composed of a *Saline principle*, of a divers nature from that of either Vegetables, or Minerals; yea more, that the *Saline, volatile spirits* of Animals, come much nearer to the nature of *Sal ammoniac*, than to that of Salts Vegetable, or Mineral. But whether these saline spirits of Animals may in all things be consistent with the *Nitro-aereous spirit* asserted by the ingenious Dr. *Mayow*; may with good reason be doubted. For, although it be said, that this

Nitro-

Nitro-aereous ſpirit doth, in paſſing through the Lungs, put on the genius of *Animal Salt*: yet it remains ſtill to be inquir'd, why Nature ſhould ordain that ſpirit to be fetch't from without from the Aire, which Animals have in abundance within them, in the Aliments præpared in themſelves. This nicety therefore I leave, as I found it, doubtful: and proceed to inquire, *Whence it is, that the Stomach infects all meats and drinks with* Acidity.

This requiſite and remarkable quality ſeems to be ſuperinduced by the Stomach upon the newly receiv'd aliment, by four ſeveral wayes, *viz.*

(Firſt) By *educing* and *ſeparating* the *ſweet and benign ſpirits* of the Aliments, from the groſſer parts of them; and then either abſorbing them into its *Venæ Lacteæ*, or tranſmitting them by the *Pylorus* into the Gutts, or diſſolving them into wind. For all nutritive juices whatſoever, ſo ſoon as the ſweet and eaſily diſſipable ſpirits, that præſerve them, are exhaled, grow acid: as is commonly obſerved even in Milk, whoſe fugitive ſpirits being for the moſt part drawn forth by the ſtomach, and thence diſcharg'd by belching; the remaining part ſoon acquires to it ſelf ſomwhat of acidity. But the truth is, this Eduction of ſpirits, though it make way for acidity to ſucceed, doth not yet produce it in that degree which we frequently perceive in very ſowr belchings: and therefore we are obliged to advance to the

Second Cauſe, which conſiſts in this; that the ſtomach turns liquors ſowr, by bringing their *Saline principle* or element, to the ſtate of *Fuſion*. For, this Saline Principle, while it remains fixt, retains its ſaltneſs: but being advanced to the ſtate of fuſion, ſoon becomes *acid*, and that ſo much the more fiercely, by how much the nearer it is promoted to *Volatility*.

Whence

Whence it is, that meats and drinks long detained in the ſtomach, are obſerv'd to acquire vehement acidity. So likewiſe when any of the *Glandules*, that ſerve either to *ſecretion*, or to *reduction*, have, by reaſon of their obſtructions, long detain'd in them the humors that remain to be carried off, after the diſtribution of the *Succus nutritius*; they cauſe them by that means to grow more and more *acid* by degrees, to the no ſmall detriment of health. Of this we have a remarkable Example in ſharp and acid *Catarrhs*; which ſeem to owe their origin to the recrements of the brain and nerves, longer than is fit retain'd in the Glands deſtined to their ſecretion and exportation; and by reaſon of their ſtagnation, grown acid; and which ſomtimes become ſo extreamly ſharp, as to corrode and ulcerate the Tonſills, throat, noſe and other parts they touch. Of this way of converting the fixt ſalt of mixt bodies into an *Acid*, only by *Fuſion*, I ſhould here have ſaid much more, had I not ſaved my ſelf that labour, by explaining the ſame expreſly and copiouſly in the ſeventh Chapter of my Book *de Scorbuto*, where I endevor to trace out the Genealogie of that ſort of *Scorbute*, which ſeems to ariſe from the prædomination of *Acid* Humors. Referring therefore the unſatisfied to that diſcourſe, I ſhall add only this neceſſary advertiſement; that this ſeems to be the cauſe, why the reliques of the former meal often contract ſo great a ſharpneſs, that if they chance to be thrown up by vomit, they ſet the very teeth on edge, and excoriate the throat by their cutting ſowrneſs; and that the natural uſe of this acid liquor in the ſtomach, is that, as a kind of Menſtruum, it may ſerve to diſſolve the ſolid meat, or at leaſt to extract a tincture of it the ſooner. For, ſo far is it from being nutritive, that it is on the contrary, a great deprædator, if conſider'd

ſider'd apart by it ſelf, and not mitigated by commixture with the ſweeter parts of the Chyle. It cannot then be deſign'd by Nature, as requiſite to the natural conſtitution of the Chyle, but only as a fit inſtrument for the diſſolution of ſolid food. Which is abundantly confirm'd by the very taſte of the Chyle, which in its natural ſtate, is alwayes ſweet.

(Thirdly) The ſtomach produces this Acidity, by mixing with the newly receiv'd meat, both the acid reliques of the former meal remaining in it, and the acid Phlegm brought into it from the arteries. Which mixture is yet ſo far from conducing to the perfection of the Chyle, that it rather renders the ſame ſo much the more impure. For the *Venæ Lacteæ* admit not the Chyle, until the pure and ſweet part of it hath been ſeparated in the Gutts from the acid: as appears from the ſweet and mild taſte of the liquor contain'd in them. Which is another argument, that the Acidity contracted in the Stomach belongs not to the nature of the Chyle, but is requiſite only to the diſſolution of the ſolid meats.

(Fourthly and Laſtly) The ſtomach induces acidity, by this, that the principles or elements prædominant in its native conſtitution, namely *hungry ſpirits* and a *ſharp ſalt*, being actuated and inſtigated by the vital influx, act powerfully upon the newly admitted aliments, and (according to the manner of all natural Agents) endevor to aſſimilate them to their own nature, *i.e.* to imbue them with their qualities. To effect this, 'Tis neceſſary they ſhould promote the fixt ſalt of the food, to the ſtate of *Fuſion:* which being once atchiev'd, that ſalt ſoon grows acid, and comes near to the ſharpneſs of Vinegre, if it be a *Vegetable* ſalt, ſuch as is contain'd in bread, ſugar, honey, beer, wine, and almoſt all ſorts of drink. For, *Fleſh* indeed doth

doth not with equal facility turn sowr, nor suffer its spirits to be so soon exalted. Whence we may learn, that to put flesh into ale, beer, wine, or any other drink, in hope to render the liquor more nutritive and strong, is a vain thing; because it communicates to the liquor, little or nothing of its nutritive virtue. And in the stomach, all flesh is sooner or later dissolved into a kind of gelly, or at least leaves a strong tincture in the drink commixt with it: and if detain'd too long therein, it becomes salt, egre or rancid; the fixt salt of it being fused, acquiring acrimony or rancor, rather than acidity. But this happens, not in the natural state of Concoction, but when the stomach is by some error committed in diet, hinder'd from doing its office rightly.

From what hath been here said, concerning the four Causes of the Acidity induced upon the Aliment, by the stomach, in the act of Chylification, we may collect, That all food consisting of Vegetables, passes through three several States or Conditions, before it is brought to the perfection of Chyle, first it is made Acid, then salt, and at length sweet. How it comes to acquire to it self the first and second of these Qualities, we have already seen. It remains then to be inquir'd, *How the Chyle comes in fine to be sweet.*

To solve this Quæstion, 'tis requisite I should advertise you, (1.) That the *Acidity* of which we have been speaking, is not vehement, but *gentle* and *little*; and consequently the *Saltness* into which it is resolv'd, is likewise but *gentle* and *weak*: for, both are to be distinguisht, as well from the acid reliques of the former meat, as from the dissolving ferment of the stomach, neither of which are hardly ever elaborated into good Chyle. (2.) That this gentle Acidity when it is converted into as gentle saltness, loseth it

dominion to the fixt ſpirit of the meat, which now advanced to the middle degree of Fuſion, over-powers and conquers it: and yet this prævailing ſaltneſs is no more, than what may juſt ſerve to a due conditure of the Chyle. For, as it did not abound in the food before concoction; ſo neither doth it exceed that proportion after in the Chyle, there being nothing of new ſalt added to it in this mutation. As therefore, in the ripening of Fruits, there intervenes an *Acid* taſte betwixt an *Auſtere* or *Styptic* and a *Sweet*; and yet nevertheleſs, as the ſpirits of the fruits attain to maturity, that Acid taſte gives place to the ſucceding *Sweet*: ſo it ſeems probable, that in the Concoction of the ſtomach, the meat, its fixt ſalt being fuſed, and ſubſtance melted, doth firſt become acid; and ſoon after, its ſpirits that lay bound up and idle, being excited, become *ſweet* again, or is digeſted into a ſweet juice. And this in ſhort is the moſt rational account I have hitherto met with, of the reaſon and manner how the *Chyle* at length comes to be *ſweet*, after the ſeveral changes it hath ſuffered in the ſtomach.

But *What becomes of the Acid reliques of the meat, and of the ſaline diſſolving Ferment of the Stomach?* I anſwer, that as to this particular, I am of their opinion, who hold, that the volatile parts of thoſe *Reliques*, being tranſmitted out of the Ventricle into the Gutts, and therein exagitated, are receiv'd into the milky veins together with the Chyle, as of further uſe to the bloud it ſelf: and that the *groſs* and *unactive* parts, mixt with the unprofitable reſidue of the Aliments, are excluded with the Excrements of the belly. For, as to the *Volatile* parts; they ſeem fit to be inſervient to Nature even in one of her nobleſt actions, the generation of *vital ſpirits* in the blood: which in all Animals conſiſt, partly of *ſaline* ſpirits, partly of

*Sulphureous.*

*Sulphureous.* For, in no part of any Animal hath hitherto been found any ſuch ſpirit, as that which is drawn from Plants after fermentation. This is well known to thoſe *Philoſophers by fire* (as they call themſelves) who have long ſweat in extracting the ſpirits of blood: and yet notwithſtanding have never been able, after all their pains and tædious proceſſes, to draw any thing from thence, but a certain *ſalt* ſpirit, not much different from the ſpirits of Urine, of Harts-horn, or of Sal Ammoniac; unleſs that perhaps it was ſomwhat more ſubtile, leſs acrimonious, and leſs ingrate. And certain therefore it is (as I before affirm'd) that whatſoever of *Acid* ſalt hath not been actually converted into ſalt in the ſtomach, is ſoon after, when the Chyle arrives at the Gutts, changed into *Animal Salt*; no ſuch thing as *Vegetable Salt* being to be found in any part of any living creature. ¶.

Having now at length, (with more of haſte perhaps, than of ſatisfaction to my Auditors) run through all the general *Differences* of Aliments to be concocted, and all the various *Alterations* they undergo in the ſtomach, before they can be brought to the perfection of good and profitable Chyle: we come next to the *Third* Head of our præſent Diſquiſition, *viz.* the *CAUSES* of thoſe Alterations.

*WHICH*, though many and of various kinds, may nevertheleſs be commodiouſly enough reduced to two general Claſſes or Orders; *viz.* ſuch as are *Foreign*, or Extra-advenient to, and ſuch as are *Indigenary* or Inbred in the ſtomach.

To the *Firſt* claſſis belong all things that any way conduce to the promotion of Concoction, either by *prævious Alteration* of the *Aliments*, or by *fortifying* the *ſtomach*.

Of those that remotely conduce to the work of Concoction only by *Præparation* of the food; some correct the Crudity of it by the help of fire, namely by boyling, roasting, frying, or baking: others render it more mild and tender by maceration, in brines, lixivia's, pickles, vinegre and the like: others make the Aliments more familiar by way of hastning their Maturation: and others again intenerate, and dispose them to dissolution, by mixture of some wholsom and agreeable Ferment. Where it may be observed, that whatsoever Aliments, whether solid, as bread, or liquid, as wine, beer, ale, hydromel, *&c.* that have undergone Fermentation, before they are receiv'd into the stomach, invite other Aliments, with which they are therein commixt, to fermentation. Hence it is, that good wine, strong beer, vinegre, bread made light by leaven, and the like, help very much to digestion.

Those that do so by *corroboration* of the *stomach*, are *Peptic* or Digestive *Remedies*, as mints, roses, wormwood, Aromatics, *&c.* But all these (of both sorts) being only *Accessories* and forein, require not to be farther prosecuted in this place.

The *Inbred* Causes of Concoction are, either *Instruments* generated in the stomach, or the *Constitutions* of the stomach in which the Faculty of Concocting is founded.

1. The *Instruments* are the *Ferments* contein'd in the stomach, four in number, whereof two are *Principal*, and the other two only *Adjuvant*.

The *Adjuvant* or less powerful, are the *Humor Salivalis*, and the *Acid Phlegm* of the stomach; both which help somwhat toward the inteneration of the meat. But because they help but little, in comparison of the other two, I content my self with the bare mention of them *en passant*.

The

The *More powerful*, are the *Acid reliques* of the former meal, which tho' more efficacious than both the Adjuvant ferments, are yet in compariſon of the grand one, leſs conſiderable; and therefore I may well be excuſed, if I paſs them alſo over in ſilence: and the *proper Ferment of the ſtomach*, which being the Principal inſtrument of Concoction, deſerves to be particularly conſider'd.

The origin and nature of this admirable diſſolving Ferment (the only true *Alkaheſt* in nature) having been firſt inveſtigated, not many years paſt, by the great induſtry of the learned and judicious *Mœbius*, and profeſſedly proved by convincing experiments and obſervations, in a prolix diſſertation conteined in his Book *de Fundament. Medicinæ*; and ſince that time, much illuſtrated by our happy Dr. *Gliſſon* (*de ventric. & inteſtin. cap.* 20.) all that remains for me to do concerning it, is only to recall to your memory the moſt remarkable heads of thoſe things ye have read in thoſe diſcourſes, by giving you a *Breviary* of them. This therefore I will do, and in as few words as can with reaſon be expected.

This Ferment then is nothing elſe, but the *ſpirituoſe* and *ſaline effluvia* ſtirr'd up by the vital motion of the arterial bloud, effuſed out of the arteries into the cavity of the ſtomach and gutts, but chiefly of the ſtomach, and therein condenſed again into a ſharp, penetrating and diſſolving liquor; apt to diſſolve the ſolid meat, and to cauſe ſuch a benign *fermentation*, as tends, not to volatilization, but only to *Fuſion* of the ſame; and in fine, acting upon it, not by open force or violent invaſion, but (after the manner of *Contagioſe ferments*) rather by clancular inſinuation, and mixing it ſelf, firſt with the ſaline and ſpirituoſe parts, and then with the groſſer and leſs exſoluble.

In

In this conciſe Abridgement, I have (I confeſs) omitted two Poſitions, both zealouſly aſſerted by the later of theſe two excellent Authors, out of whoſe doctrine I abſtracted it. *One* is, that that part of the blood, which is by the *Cæliac* and two *Meſenteric* arteries, diſpenſed to the ſtomach and gutts, chiefly to the inmoſt coat of them, is ſomewhat more *ſalt* and *ſharp*, than the blood diſtributed to other parts of the body. The *Other* is, that the Saline and ſpirituoſe parts of the Meat newly admitted into the ſtomach, perceiving that they are ill lodg'd, and that the Ferment with which they there meet, is really ſemblable or like to them, and withall more noble (as retaining ſome reliques of vitality, with which it had ſo lately been ennobled, while it paſs'd through the heart and arteries) do eaſily admit, embrace and conjoyn themſelves with it.

But I declare withal, that I omitted theſe Poſitions, not from inadvertency, nor for brevity ſake; but only becauſe I doubt of the verity of them. For the *firſt* ſuppoſes *Similar Attraction*, or mutual coition of things alike, *ob ſimilitudinem naturæ*; which yet I do not find my ſelf obliged to grant. And the *other* depends upon the Hypotheſis of *Natural Perception*, which is not yet eſtabliſh'd beyond diſputation.

However, it ſeems to me ſufficiently probable, that this diſſolving Ferment is peculiar to, and generated in the ſtomach; becauſe nothing like it is to be found in any other part of the whole body: that to the conſtitution of it, is required a concurſe of both ſalt and ſulphureous ſpirits (ſuch are the vital ſpirits themſelves) but chiefly of Salt (than which nothing is more ſharp, penetrating and diſſolving): and that therefore it may be call'd, as *Mœbius* named it, *Sal ſpiritibus impregnatum, acre ac pungens*; or, as *Dr. Gliſſon*, *Fermentum Ventriculi fuſorium, ſeu principale coctionis inſtrumentum*; becauſe

cauſe it doth not only efficaciouſly diſſolve the ſolid parts of the food, but alſo give it the firſt degree of Aſſimilation to the nature of the Animal, out of whoſe blood the ferment it ſelf is derived. Which may be one reaſon, why the ſame Aliment receives a divers præparation in the ſtomachs of Animals of divers kinds; the ferment being in ſome ſorts different from that in others, reſpectively to the difference of the blood. And this is all I have to ſay of the chief *inſtrument* of Concoction, the proper and inbred Ferment of the ſtomach.

2. The *Conſtitutions* of the ſtomach, in which the Concoctive Faculty ſeems to be founded, are three; *viz.* Vital, Animal, and Natural. Of theſe, the two former are influent, the firſt from the fountain of life, the blood; the ſecond, from the brain: the third, inſite or implanted in the ſtomach it ſelf from its very formation. From all theſe Conſtitutions concurrent, and by an admirable contrivance of the Divine Wiſdom combined, there reſults a certain power, which is the Principal Cauſe of all the operations of the ſtomach. Hence we properly enough ſay, the ſtomach craves meat, and the ſtomach digeſteth. For the Seminal Principle of the ſtomach, including both the Vital and Animal influences; together with the native Conſtitution, is the whole, and ſo the Principal cauſe of all its operations. But this being a Complex cauſe, cannot be well underſtood, unleſs the three Conſtitutions here named, of which it is compoſed, be ſingly conſider'd. What the Vital and Animal are, will be eaſily collected from what I have deſigned to ſay, when I come to inquire concerning life, and the influence of the brain. And as for the inſite or congenite Conſtitution; that conſiſteth in the *Temperament*, in the *Habit*, in the *Tone*, and chiefly in the *implanted ſpirit* (as the *Galeniſt* calls it) or (as the *Chymiſts* and *Helmontians*) *Archeus*, which

which assisted by the influent vital heat, and by the Animal influx, is doubtless the grand cause of Concoction, and together with the newly describ'd Ferment, performs the whole work. Which being accomplish'd, there immediately succeeds another operation equally necessary to Nutrition, *viz.*

## *The* DISTRIBUTION *of the Chyle.*

VII. *DISTRIBUTION* of the Chyle.

*WHICH* is perform'd by three distinct actions of the Distributive Faculty of the stomach and Gutts, *viz.* (1) the Exclusion of the Chyle out of the stomach into the Gutts: (2) The *Agitation* of it to and fro by the Peristaltick motion, partly in the stomach, but chiefly in the gutts; and (3) the *Transmission* of it into the Milky Veins. The reason and manner of all which actions I shall endeavor briefly to explain; supposing them to be *Organical*.

As to the *FIRST*, viz. the *Transfusion* of the Chyle out of the stomach into the gutts, I conceive it to be effected by a double motion of the Chyle; one, *impress'd* upon the Chyle; the other, *natural* to it, or spantaneous: The first, *upward*; the second, *downward*. The *impress'd* and *upward* motion, by which the Chyle is elevated to the *Pylorus*, I ascribe to the *Constriction* or closing of the whole stomach. For, all the fibres of the stomach, by the motion of self-restitution (common to all Tensiles, after they have been extended in length) more and more contracting themselves by degrees, of necessity lessen the cavity in which the Chyle is contein'd; and this coangustation of the cavity, of equal necessity raises it up to the *Pylorus*, and (the other orifice remaining closely shut up, while the whole act of Concoction lasteth) forces it out at the same: in the same manner

manner as the liquor of a Clyſter is ſqueez'd out at the pipe, only by compreſſion of all parts of the bladder including it. The *natural* and *downward* motion, by which the Chyle ſlides down into the gutts, is to be attributed to its *Gravity*, which cauſes it to deſcend from the *Pylorus* into the gutts ſpontaneouſly.

But this later motion belongs not to that part of the Chyle, which is carried off immediately from the ſtomach by the milky veins that are proper to it. Which yet cannot be much, perhaps not the hundredth part of the whole maſs of Chyle, becauſe the *Venæ Lacteæ* of the ſtomach are but few, their number ſcarcely holding the proportion of a hundred to one, with the great multitudes of thoſe that take in their fraught from the Gutts.

Nor is all the other part of the Chyle devolved into the gutts together and at once, but by *degrees*, as it comes to be concocted. For, it is conſtant from the diſſection of Animals alive, that the Chyle, when it is confected, is fluid or liquid, and viſibly diſtinct, yea eaſily ſeparable from the ſolid meats not yet diſſolved; as broath is in a pot diſtinguiſhable from the fleſh boyl'd in it. And becauſe the ſolid meat is for the moſt part heavier than the liquor, and therefore ſinks to the botom of the ſtomach; it muſt needs by preſſure cauſe the liquor to riſe to the Pylorus, to give way to what preſſes it: So that the thinner part of the Chyle is always firſt expreſs'd. For the two orifices of the ſtomach are of equal height, and both a little higher than any other part of the ſame. Whence may be collected one good reaſon, why 'tis more conducible to health, to ſit or ſtand, than to lie down, upon a full ſtomach. For in a man that keeps the Trunc of his body in an erect poſture for ſome time after meat: the load of the ſtomach creates little or nothing of trouble to the orifices of it, but beareth only

upon the bottom and ſides. Whereas he that lies down ſoon after he has fill'd his belly, inverts the order of his meat, and turns the liquid part out by the Pylorus, before it hath been ſufficiently concocted; and ſo fills his body with crudities, than which I ſcarce know any thing more pernicious to health. And this ſeems to me ſufficient to explain the reaſons and manner of the *devolution* of the Chyle into the gutts, which is the firſt act of the Diſtributive Faculty.

As to the *SECOND*, viz. the *Agitation* of the Chyle to and fro; this equally diſtributes the Chyle to all the gutts, as is not only convenient, but of abſolute neceſſity to Nutrition. For, ſince Nature hath diſpens'd *Venæ Lacteæ* equally to all the Gutts, 'tis fit the Chyle alſo ſhould be equally diſtributed to them all, ſooner or later, that each one may have its ſhare of the dividend. Again, ſince only the outward ſuperfice of the matter contein'd in the ſtomach and gutts, bears againſt the orifices of the *Venæ Lacteæ*, and ſince the *Venæ Lacteæ* do not hang forth, or ſtand ſtrutting into that matter, but are terminated in the interior membrane: 'tis requiſite, the matter ſhould be turned and revolv'd to and again, that the whole may at length be brought to their doors and offer'd to them.

Now this is effected wholly by an operation *Organical*, and the Efficient is the *Periſtaltic Motion* of the ſtomach and gutts, proceeding from the alternate contraction and extenſion of their Fibres, as we have this day ſhewn, when we deſcribed the Periſtaltick motion, and gave a Mechanic account of it. Chooſing therefore rather to exerciſe your Memory, than to abuſe your Patience by a vain repetition of the ſame things; I will here conſider only the *Congruity* of the figures

figures of the ſtomach and gutts, to the Diſtribution of the Chyle, by virtue of this Agitation.

As the ſtomach has the advantage in the office of Concoction, ſo is the power of the Gutts, paramont in the buſineſs of Diſtribution: and therefore Nature, which conferr'd theſe powers in different degrees upon them, and always accommodates her inſtruments to their proper uſes and ends, fram'd them of Figures moſt commodious reſpectively to their peculiar functions. In particular, ſhe made the *ſtomach* more *ample*, but *ſhorter*: and therefore fitter to Fermentation of the aliment: becauſe by how much the more profound any Cavity is, by ſo much more contracted is the ſuperfice of the matter therein contain'd (ſuppoſing the quantity equal) and conſequently ſo much the leſs of it comes to touch the ſides of the cavity within; and *è contra*. The *Gutts* ſhe made *ſlenderer*, but *longer*; and therefore the apter to Diſtribution; becauſe gracility conjoin'd to longitude, promotes Diſtribution, in three ſeveral reſpects. (1) The narrow or ſlender cavity of the Gutts, wanting deep profundity, applies it ſelf to the more parts of the Chyle contein'd in it at once: (2) by reaſon of its great length, it affords room ſufficient to the greater number of Milky veins to range themſelves in the interior ſuperfice of it, and (3) by reaſon of the gracility and length conjoyn'd, the Chyle is more eaſily commoved from the centre to the circumference. Hence then we come to underſtand the reaſon, both of the gracility, and of the length of the Gutts.

The *Uſe* of this diſtributive motion is threefold. (1) The reduction of all things contein'd, whether in the ſtomach or in the Gutts, to an equal diffuſion, ſo that they may not lie congeſted in one place, and be deficient in another: (2) The opportune admotion of

the whole mass of Chyle to the orifices of the Milky veins: (3) the facilitation of the descent of the Chyle. Of these Uses, the first and second are more eminent in the Gutts by much, than in the stomach: because (as I said but even now) but very little, scarce the hundredth part of the Chyle is brought to the orifices of the *Venæ Lacteæ* in the stomach; the main stream of it running down into the Gutts. But the Third is more conspicuous in the stomach: because the Chyle that is by this motion devolved to the *Pylorus*, rarely slips back again, but falls down by that aperture into the Gutts, to the end it may be thence transmitted into the *Venæ Lacteæ*, which is the

*THIRD* and last act of the Distributive Faculty, and seems to me to be done, chiefly by Constriction of the Gutts, and partly by their compression by the Muscles of the Abdomen assistant to Respiration; not by Attraction or Exsuction of the Chyle by the *Venæ Lacteæ*.

First I say, chiefly by *Constriction* or *Contraction* of the Gutts; because 'tis evident to sense, that the chyle coming into the gutts, fills their cavity, swells them up, and distends their membranes; and consonant to reason and the law of all nervose and fibrose bodies, that the fibres of the Gutts, irritated by that distension, should endevour to recontract themselves to their natural state and position. Now this they cannot do, but they must at the same time gird in the membranes, and streighten the cavity of the gutts: nor can the cavity containing be lessened, without pressing the liquor contained, and forcing it to recede some way or other. Upwards it cannot retire, because the mouth of the stomach is barricadoed against it: downward it cannot evade, that gate being shut by the Sphincter of the fundament: other way there is none,

none, but only that which leads into the *Venæ Lacteæ*. This way then the Chyle must take, to deliver it self from pressure by the spontaneous Constriction of the Gutts. Whence I am apt to conclude, that the Chyle is transmitted from the gutts into the *Venæ Lacteæ*, by way of *Expression*: and that the proxime and principal cause of that Expression, is the spontaneous Constriction of the fibres of the gutts.

Secondly I say, partly by *external Compression of the gutts*, by the Muscles of the *Abdomen* cooperating to the motions of Respiration: because 'tis most certain, that by the contraction of these Muscles, the Gutts are compress'd almost on all parts; and no less certain, that this compression helps them to squeez out whatsoever is contein'd in them: as appears in exclusion of the excrements of the belly, in breaking wind, in belching, *&c.* If the Contraction of these Muscles (such I mean, as is ordinarily made in *Expiration*) be thought too weak to compress the gutts to a degree requisite to express the Chyle; I can justly call in the depression of them by the *Diaphragm* in *Inspiration*, to the assistance thereof: and that hath been held of so great force to the Expression of the Chyle out of the gutts into the Milky veins, even by *Monsieur Pecquet* himself (a man of solid Erudition, an acute judgement, and curious to explicate natural things by Mechanic principles) that writing of the motion of the Chyle (*in dissertationis Anatomicæ cap.* 11.) he fear'd not to ascribe very much to it, in these words. "*Ad respirationem redeo, in qua dum pul-*
"*mones dilatantur, etiam deorsùm diaphragma premunt,*
"*jecurq; quod tum pistillum agens, succutientis per inter-*
"*valla molis gravamine, non solum adigit chylum è ventri-*
"*culo per Pylorum in intestina secedere; sed eorundem disten-*
"*dit porulos, illicq; subtilissimam impellit in lacteas alimen-*
"*ti substantiam.*

If

If it be *objected*, that the depreſſion of the ſtomach and gutts by the Midrif, cannot concurr with the Compreſſion of them by the Muſcles of the Abdomen; becauſe the contraction of theſe, is not Synchronic or coincident with the diſtenſion of that: I have this to *anſwer*. True it is indeed, that theſe motions are alternate, that is, when theſe Muſcles are contracted, the Midrif is relax'd upward, and by filling the lower part of the cheſt, expels the breath upward; and ſo *Expiration* is perform'd: and on the contrary, when the Midrif is diſtended, at the ſame time theſe Muſcles are relaxed, the bowels depreſs'd, the cavity of the cheſt inlarged, and the air ruſhes into it from without, and ſo *Inſpiration* is made. This, I ſay, is true: but this truth ſeems not to impugn the opinion I now defend. For, as often as the Compreſſion of the Stomach and guts by the Contraction of theſe Muſcles, is intermitted; ſo often is their Depreſſion by the diſtended diaphragm, repeated or renewed: So that though theſe motions be alternate, the preſſure of the gutts, and conſequently of the Chyle contein'd in them, is continued; and as to the Expreſſion of the Chyle into the *Venæ Lacteæ*, 'tis all one whether the preſſure be from above or on the ſides. I have ſeen young Lads at *Paris*, for ſport, take the skin of a Snake, neatly ſtript off from head to tail, fill it with water, then prick it through with a needle in many places, and in fine by either preſſing the water from one end toward the other, or compreſſing it hard in the middle, force it to flow forth in as many ſlender ſtreams, as the needle had made holes in the skin. And this (methink) is a pretty lively repreſentation of the manner of the Expreſſion of the Chyle out of the guts into the Milky veins.

Thirdly

Thirdly I say, not by *Attraction* or *Exsuction*, as is generally believ'd. For (1) Natural Philosophers are not yet agreed upon the point, whether there be in nature any such thing as Attraction, properly so call'd, or not: and they that are on the Affirmative part, seem to me to have the worst end of the staff; it being much more probable, that all the motions attributed to Attraction, are really perform'd by *Impulsion*. (2) Although it were granted, that some bodies may be moved by others by way of Attraction; yet would it still remain extremely difficult to find, what should cause the motion of the Chyle, of which we are now speaking, by the same way. Of all Attractions mentioned by Philosophers, there are (if my weak memory deceives me not) but three differences or sorts, *viz.* Attraction *ob fugam vacui*, Attraction *Organic*, and Attraction *Similar* or *ob similitudinem substantiæ*. But no one of these seems to have place in the effect here propos'd. Not the *first*; because the *Venæ Lacteæ* are not, by reason of their exiguity, capable of such a *vacuum coacervatum*, as the *Aristoteleans* require to cause attraction of even fluid bodies: nor do they contain any *disseminate vacuities* (as they call them) when they are not fill'd with Chyle; because then they close themselves and draw their sides together, in so much that they wholly disappear. Here then is no danger of vacuity, and consequently no necessity of Attraction for avoidance of it. Not the *Second*; because the *Venæ Lacteæ* have no hooks, chords, or other instruments, wherewith to take hold of the Chyle, and draw it into their mouths out of the gutts. Nor the *Last*; (1) because all Similar Attraction supposes *Natural Perception*, than which nothing is (to me at least) more doubtful: (2) because the affinity or similitude of nature required to be betwixt the Attrahent, and the thing to be attracted,

attracted, is here wanting; for, what is there of *resemblance* in substance, or qualities, betwixt the Milky veins, on one part, and the Chyle, on the other? This is a *fluid*, those are *solid* bodies: the Chyle is a liquor composed of *heterogeneous* or dissimilar parts; the *Venæ Lacteæ*, on the contrary, are *Similar*, spermatic parts. Wherein then consists the ὁμοίωσις or *Analogy*, that should cause an attraction of the one by the others? If it be said, that, not the *Venæ Lacteæ* themselves, but the reliques of the former Chyle remaining in them, attract the new Chyle, *ob similitudinem substantiæ*. First we may deny, that, in the state of health, any thing of Chyle is to be found remaining in the Milky veins, after the work of distribution is finished; and justify this our denial by the testimonies of all Modern Anatomists who have written of the motion of the Chyle, and of the *Venæ Lacteæ*. And then we may ask of the Patrons of Attraction Similar in this case, Why the Chyle contain'd in the gutts, being vastly more in quantity, should not rather attract the supposed reliques left in the *Venæ Lacteæ*? Besides all these reasons daily Experience assures us, that not only pure and nutritive Chyle, but the particles of Purging and other ungrateful and offensive Medicaments, are received into the *Venæ Lacteæ*; which they would never admit, in case they attracted the Chyle *Electivè*, by election or choice, as the supposition of *Similar attraction* implies. To conclude therefore; it was not without reason I said, that the Chyle is not transferred from the gutts into the Milky veins by way of Attraction or Suction, but only of *Expression*.

This may be confirmed by the very manner of the transmission of the Chyle into the *Venæ Lacteæ*, which seems to be, not immediately from the cavity of the intestines, but through the inmost Tunic of them, and that by way of *percolation*. *First*

*First* I say, *not immediately from the cavity of the stomach and gutts*; because 'tis demonstrable even to sense, by various Anatomic experiments made in the bellies of Animals alive or dead, that the *Venæ Lacteæ* do not perforate or pass through the stomach and gutts, but are all terminated in the inmost coat that lines them. For, neither by *injection* of liquors, nor by *inflation* with air, nor by the strongest *compression* whatsoever, can any thing be made to pass from the stomach or gutts into the *Venæ Lacteæ*, whether the Animal be open'd alive or dead, full or fasting. Whence 'tis sufficiently manifest, that these veins do not open themselves into the cavity of the stomach, or into that of the intestines; for, if they did, what can be imagined to hinder the ingress of liquors, or air, when vehemently urged by compression, into them? Wherefore I say

*Secondly*, that the Chyle is transmitted by *percolation*, through the very *Parenchyma* of the stomach and gutts, *tanquam per manicam Hippocratis*, as through a streiner. For, it is not the custom of Nature to institute any secretion or separation of humors without a *Colatory*: nor doth she use, where there is need of a streiner, to ordain a single membrane, but some peculiar *Parenchyma*, to that purpose; much less to delegate that office to the naked orifices of vessels of what kind soever. For, the orifice of a vessel, as simply such, *i.e.* as a mere organ, promiscuously admitts whatever is brought to it; not separating one liquor from another, the thinner from the thicker, the pure from the impure, but taking in without discrimination all that comes. Seeing therefore that Nature for the separation of different liquors confused, is always observed to use some *Parenchyma* as a *Colatory* or Streiner; and seeing no other sufficiently noble and considerable use can be assign'd to the Parenchyma of the inmost Tunic of the stomach and

gutts, but this I now attribute to it: these things (I say) duly consider'd, I think it most probable, that the *Parenchyma* of this *Tunic* doth perform the office of a Streiner to the Chyle, receiving and conveying into the Milky veins, the thinner parts thereof, and excluding the gross and excrementitious; as an *Hippocras* bag transmitts the Wine, but retains the Spices infused in it.

Now this very *Percolation* of the Chyle doth (as I just now hinted) not a little confirm my former assertion, that it is distributed from the cavities of the Ventricle and gutts, not by Attraction or Extuction, but only by *Expression*. For, what can be imagin'd more likely to impell it, or drive the thinner parts of it into, and through the Streiner, than *Pressure?* or whence can that pressure come, but from the *Spontaneous Constriction* of the stomach and gutts, conjoyn'd with the alternate *Compression* of them by the *Diaphragme* in inspiration; by the Muscles of the *Abdomen*, in exspiration?

Why then should not Anatomists be able, by compression or any other way whatsoever, to force the Chyle, or other liquor injected, through this *Parenchyma* or supposed Streiner?

I answer (*First*) that the Mechanic Ration of this *Colatory* being not yet (for ought I know) discover'd, even by those curious Dissectors, who have with the best Microscopes contemplated the texture of it; I dare not pretend to understand the true reason of the difficulty objected. (*Secondly*,) that if I were permitted to declare my present conjecture concerning the same, I should venture to say; that the impediment to the *manual expression* of liquors out of the gutts into the Milky veins, in Animals dissected alive, may perhaps consist in one of these two things: either that of the

several

ſeveral cauſes or motions, in the ſtate of health and eaſe or indolency, concurring to this complex and organic operation, one (or more) is wanting; and the Mechaniſm of the principal Organ, the interior Membrane of the gutts, altered and vitiated, in the præternatural and doloroſe ſtate of the Animal diſſected: or, that by reaſon of the cruel torments the miſerable Beaſt feels, the *Tone* of the gutts becomes ſo ſtrongly contracted and rigid, as to be wholly impervious. Which is the more probable, becauſe 'tis well known, that great and acute pain always irritates nervoſe and fibroſe parts to contract themſelves, even to rigidity; which is oppoſite to the gentle compliance and yieldingneſs requir'd to permeability. Which may be one cauſe, why Nature hath endow'd all *Glandules* ordain'd for *Secretion*, with ſo little ſenſe; *viz.* leſt otherwiſe, being ſenſible of every light irritation, they might be apt to ſhrink and condenſe themſelves, to the interruption and hinderance of their office. And for Animals diſſected after death; I ſhould gueſs, that in them, the Colatory of the Chyle is rendered impervious by *Cold*, which by ſtrong conſtriction or conſtipation ſhutts up all ſlender and inconſpicuous paſſages of the body, that had been kept open by the heat and motions of life. But theſe are my private Conjectures (as I have already declar'd) offer'd rather to your examen, than to your belief. So is whatſoever I have ſaid in this diſquiſition, concerning the *Diſtribution* of the Chyle; which I here conclude. ¶.

There remain yet two other *Faculties* of the *ſtomach* to be conſider'd, *viz.* the *SECRETIVE*, by which it ſeparates from the blood brought into its membranes by the Arteries, a certain ſlimy and ſub-

acid *mucus*, call'd *pituita emortua*, dead Phlegm, becauſe the ſpirits thereof being exhauſted, it is of no further uſe to the blood: and the *EXCRETIVE*, by which it exonerates it ſelf of that dead Phlegm, of the ſowre reliques of the food, of its own decay'd Ferment, and in fine of whatſoever elſe is unprofitable or offenſive; and that either upward, by Eructation, or by Vomit; or downward into the *inteſtines*. But becauſe the explication of the Conſtitutions of the ſtomach upon which theſe Powers are chiefly founded, and of the different motions and ways by which they are reſpectively executed, is leſs pertinent and requiſite to the ſhort Hiſtory of Nutrition at this time by me deſign'd, than thoſe precedent are, upon which I have hitherto inſiſted; and becauſe the Sands in my glaſs are a good while ſince all run down: therefore I find my ſelf doubly obliged to pretermit the explanation of them; leſt I ſhould at once, both rove from my principal ſcope, and further tranſgreſs the law of this *Royal Colledge*, which hath ſet bounds to all Exerciſes of this kind when here perform'd.

By the *later* of which reaſons I am hinder'd alſo from tracing the *Chyle* in the narrow, obſcure, and anfractuoſe ways, through which it paſſes, before it can attain to the end of its journey; and from obſerving particularly the *Mutations* it undergoes, the *Exaltation* and *Refinement* it gradually acquires, and the *Secretion* of its unaſſimilable parts, made in Organs by Nature to that uſe ordain'd. Let it therefore at preſent ſuffice, if to gratifie the Curioſity of the Yonger Students of Anatomie, I ſet before their eyes, not an accurate Map, but a rude *Landskip* of the *Galaxy* or Milky way, in which the greater part of the Chyle glides along through the *purple Iſland* of the body, to repleniſh the ocean of blood.

The

The *Chyle* being now (as I ſaid) ſqueez'd out of the ſtomach and gutts, into the ſlender pipes of the *Venæ Lacteæ*, flows gently on in them from the Circumference toward the Centre of the *Meſentery*; the precedent parts of it being neceſſarily puſht forward by the ſuccedent (*ut unda undam pellit*) till it enter into certain *Glandules* there placed. And this may be call'd, the *Firſt* ſtage of the Chyles progeſs through the *Galaxy*. Extruded from thence, partly by more Chyle crowding in, partly by compreſſion of the *Glandules*, by the diſtended *Midrif*, and contracted *Muſcles* of the *Abdomen*, it flows into the *Common Receptacle* or Ciſtern, firſt diſcover'd by the Curioſe and fortunate *Monſieur Picquet*, and thence call'd by his name. Which I accompt, the *Second* ſtage or remove of the Chyle. From the *Common Receptacle* (which conſiſting of a membranoſe ſubſtance, ſituate at the very root of the *Meſentery*, upon the ſphondyls of the *Loins*, and filling up the ſpace between the *Muſcles Pſoæ*, is incumbent upon the two long and fleſhy productions of the *Diaphragm*) the *Chyle* is transferr'd into the *Ductus Chyliferus*, which running upward, near the ſpine of the back, and continued quite home to the *Subclavian* branches of the *Vena Cava*, exonerate themſelves into them, and commix the Chyle with the blood: and this alſo ſeems to be done by *impulſe* or protruſion. Becauſe the two Productions of the *Diaphragm*, lying immediately under the Common Receptacle, cannot be diſtended (as together with the *Diaphragm* they always are, in every *inſpiration*) but they muſt force the Chyle therein contain'd, to give way, by aſcending in the pipes that from thence tend upward; after the ſame manner as in artificial fountains, the water is mounted into pipes, only by preſſing the ſurface of that in the Ciſtern. Perhaps the ſo often men-

mention'd *Compreſſion* of all parts included within the *Abdomen*, by conſtriction of the Muſcles thereof, may not a little contribute to this *Elevation* of the Chyle; which is the *Third* remove of it. Next, the Chyle, by the ſaid *Subclavial* veins brought into the *Aſcendent* trunc of the *Vena Cava*, is immediately imported, together with the blood therein deſcending, into the right ear, and ventricle of the *Heart*. Which by its *Syſtole* or contraction, ſqueezes it into the *Lungs*, where by their Reciprocations it is more perfectly mixt with the blood, and whence it is devolv'd into the *Left* Ventricle of the Heart, and finally thence ſquirted into the *Arteries*, ſo ſoon as it hath receiv'd the form and name of blood. Which is the *Fourth* and laſt ſtage of its journy; at leaſt of ſo much of it, as is ordain'd to recruit the maſs of blood, and afford matter for the ſupply of the *Vital ſpirits* or *Heat*.

For, I bluſh not here to declare my adherence to the doctrin of that great Light and Ornament of this Colledge, Sir *George Ent*, that a conſiderable portion of the moſt delicate and ſpirituoſe Chyle, is never brought, through the *Galaxy* newly by me deſcrib'd, into the blood; but detach'd, and by other ways, by membranes and nerves and fibres (perhaps by way of *Filtration*, as the nouriſhing juice of Plants ſeems to aſcend from the roots up to the top of the higheſt ſpriggs) transferr'd to the brain, and by *Meteorization* refin'd into the laſt aliment of the *Spermatic* parts. Which I do, not becauſe I have hitherto zealouſly aſſerted this doctrin, both *in Exercitat.* 10. *lib. de Oeconomia Animali, & lib. de Scorbuto cap.* 8. but only becauſe the Arguments and Experiments brought againſt it, by *Deuſingius* and ſome other Defendents of that antique Placit of *Ariſtotle*, *Sanguinem eſſe ultimum alimentum partium*; are not (in my judgement) half ſo weighty

weighty and cogent, as those brought to recommend it to the belief of an equal Arbiter. Of all the *Objections* hitherto put into the oppoſite end of the ballance, the moſt ponderoſe ſeems to be that, which hath been, by way of induction, alleged by my Learned Collegue, Dr. *Lower*, from a remarkable Anatomic Experiment made by himſelf, and recorded in his Book *de motu Cordis & Sanguinis, cap.* 5. Whence he inferrs, that the whole revenue of the *Chyle* is certainly expended upon the bloud: and yet notwithſtanding, I dare affirm, that though the Experiment be true and ingenioſe, the inference is more than can be, according to the Laws of right ratiocination, from thence deduced.

The *Experiment* it ſelf is (in ſhort) this. If in a Dogg, or any other Animal, fed about three hours before, the pipe leading from the *Common Receptacle*, then fill'd with newly imported Chyle, be broken (as without much difficulty it may, by making a convenient inciſion betwixt the two loweſt ribbs of the right ſide, and tearing the Receptacle with the nail of the fore-finger) ſo as the courſe of the Chyle into the *Thoracic* veſſels be intercepted; the poor Animal, how plentifully ſoever ſupplyed with food, will nevertheleſs periſh by *famine*, within few dayes after; and in his breaſt will be found a deluge of Chyle.

The *Inference*, this. Certain it is therefore, that the Animal, though abounding with Chyle in the ſtomach, gutts, and milky veins, dies nevertheleſs of *famine*, by reaſon that the Chyle cannot aſcend, by the *Thoracic* pipes, into the *Subclavial* veins, but is intercepted by the way: and by conſequence, that the whole ſtock of Chyle is imported, by the chyliferous veſſels, into the *bloud*. Which to me ſeems to be a *Paralogiſm*.

For,

For, granting, that whatever of Chyle is brought from the *Common Receptacle* into the mass of bloud, passes thither by no other way, but through the *Thoracic* pipes: it will not therefore necessarily follow, that the whole provision of Chyle made in the Ventricle, is convey'd thence into the Common Receptacle, and so into the bloud. For, why may not some part of it be *diverted* into other wayes, from the *Ventricle* by the membranes thereof, from the *Glands* of the *Mesentery*, from the *Lumbares*, and others vicine to them? Chiefly when the wayes of that diversion or detachment are sufficiently probable; as I have many years past shewn, *ex professo*, in my Exercitation *de distributione Succi Nutritii per membranas & nervos:* and when otherwise the *spermatic* parts of the body would all be destitute of requisite nourishment; the bloud being so unfit to repair their exhaustion, that in all probability it rather preys upon, and consumes them; as hath been with many nervose reasons asserted by Dr. *Glisson*, in *lib. de Anatom. Hepat.* Nor is it necessary, because the Doggs upon which this Experiment hath been tried, died within few daies after, that therefore they died of *famin.* For, why might not so great a wound, penetrating into the cavity of the Thorax, be sufficient of it self to destroy them, in that space of time? Why is it not more consentaneous to conceive, that in those Doggs the bloud it self being depriv'd of the requisite afflux of new Chyle daily, and so alienated from its vital constitution, as to have been no longer fit to afford a continual recruit of spirits, became vappid; and so inferr'd death, in a few dayes? though the solid parts were not defrauded the while of their portion of the Chyle brought to them by other wayes. That in long fasting, when new Chyle is wanting, the bloud doth

doth usually estuate, grow acrimonious, and prey upon the substance of the body: is a truth so well known by common experience, that it needs not farther probation. But how long after the wounds had been inflicted, did the Doggs live? That our *Author* forgot to record; leaving the number of the dayes undefin'd, notwithstanding the Circumstance of time be of great moment toward the strengthning his supposition, that they perish'd meerly by *famin*. For, if they surviv'd but two, three or four dayes, 'tis more improbable they should be in so short time *starv'd* to death, than that they perish'd only by the *wounds* they had receiv'd. Again, 'twas necessary, that by so great quantity of Chyle effused into the cavity of the *Thorax*, the motions of the *Diaphragm*, *Heart*, and *Lungs*, should be highly impeded; that from the putrefaction of the same Chyle, an acute fever should be soon kindled; and that the whole Oeconomy of Nature should be, in so great streights, perverted into mortal confusion, in those suffering Animals. There are then (you see) other causes, besides the interception of the Chyle, to which the death of the Doggs may be with more of verisimilitude ascrib'd. Where then is the necessity of that conclusion, that *Famin* alone kill'd them? or how doth this Experiment demonstrate, that the *whole revenue* of Chyle is, as a due tribute, paid into the Exchequer of the bloud? I am therefore to be excus'd, if I deny this mighty *Objection* to be of force enough to subvert the doctrine of the *Nutrition* of all the *spermatic* parts by the *Succus nutritius*, clearly distinct from the bloud.

More considerable it is, that even that Great Man, Dr. *Franc. Glisson*, who had (*in lib. de Anat. Hepat. cap. ult.*) with so many, and so strong arguments drawn from reason and observations, propagated this

doctrine; hath notwithstanding, in his last and most elaborate work (*de Ventric. & intestin. cap.* 8.) taken occasion to retract it, in these very words. "*Hîc* "*tres Errores à me olim admissos ultrò agnosco & revoco.* "*Conjectabam quidem tunc* (1.) *Materiam succi nu-* "*tritii esse selectissimam Chyli partem*; (2.) *Hanc per* "*viam secretionis in glandibus quibusdam, potissimum* "*Mesenterii, à reliquo chylo separari, & per nervos ad* "*cerebrum transmitti*; (3.) *Nervos splenicos è liene* "*succum quendam tenuem & mitem, qui sit vehiculum* "*prioris, eligere sive exsugere. Hisce tribus sententiis* "*hîc valedico, & argumenta, in quantum iis stabiliendis* "*inserviant, improbo*; *& similiter Corollaria, si quæ sint,* "*in quantum ab iis solis dependeant, rejicio.* This *Palinodia* of his did, I confess, not a little surprize me, when first I read it: but my amazement lasted not long. For, when I had found, that as to the *Reasons* inducing him to make that Recantation, his silence had left me wholly in the dark; and that in the lines immediately following he had subjoin'd this *limitation* of it, "*Interim non nego, quin detur verus succus* "*nutritius à cerebro per nervos ad omnes partes sperma-* "*ticas dispensatus*; *aut quin sit subjectum spirituum ani-* "*malium. Sed aio, generari hunc succum in solo cere-* "*bro, inter corticem ejusdem & medullam, per viam se-* "*cretionis*; *& sanguinis mitiorem partem magisque sper-* "*maticam esse materiam, &c.* I perceiv'd, that though he had, by his Authority, shook some part, he had not yet demolish'd the whole of that fair structure by himself formerly erected. And I have reason to believe, that he had never affirm'd, that the true *succus nutritius* is deriv'd out of the bloud; had not Fate, thinking the honor he had before acquir'd by other noble discoveries in Nature, sufficient to give him immortal renown, reserv'd the glory of farther revealing the

the myſterie of Nutrition, for Sr. *George Ent*. Who, in his incomparable *Antidiatriba* lately publiſh'd, hath eternally obliged the world by declaring his ſentiments concerning the *Matter*, *conditions*, and *generation* of the true *ſuccus nutritius*; as alſo concerning the *Manner* and *Wayes* by which the ſame is diſtributed to all parts of the body thence to be recruited. To that Aphoriſtical Book therefore I referr all thoſe of my *Auditors*, who deſire to be more fully ſatisfied in this matter: and ſo conclude this my imperfect Hiſtory of *Nutrition*. ¶.

PRÆLECTIO

# PRÆLECTIO IV.

## Of Life.

THE Climax or Scale of Nature, by which she advances in her Works from less to greater Dignity and Perfection, and distinguishes all things Animate into three general Orders, consisteth (as ye well know) of only three Rungs or Degrees: of which the first is simple *Vegetation*, to which all Plants are confined; the second, *Sense*, which includes Vegetation, and is the *Ne ultra* to all brute Animals; the third, *Reason*, which comprehends both Vegetation and Sense, as inferior and subordinate, and Constitutes the royal Prærogative of Man, above all his fellow Creatures that are [τὰ ἔμψυχα] composed of Soul and Body. To each of these degrees *LIFE* is annext; for even Plants themselves are, by Universal consent of Mankind, allowed to *live* and *dye*, as well as Sensitive and Rational Creatures: and ζῶον *dicitur* ἀπὸ τοῦ ζῆν. *Sic* Plato (*in* Timæo) *quicquid* τοῦ ζῆν, *i. e. vivendi particeps est, jure Sane* ζῶον (*quasi vitale dixeris*) *id est animal rectissimè appellari potest. Insunt autem & plantis ipsis facultates vivendi, nutriendi, crescendi, sui q; similè producendi. Sic etiam* Arist. (de gen.

Animal.l.2.c.i.) *Sive planta, sive Animal est*, inquit; *æque omnibus inest, quod vim habet vegetandi, sive nutriendi*, &c. but not Life of one and the same kind; for the Life of Brutes is more Energetic, and consequently more Noble than the Life of Plants; and the Life of Man much more Noble than that of Brutes. And this of absolute Necessity, because a sensitive *Soul* is endowed with more and higher Faculties or Powers, than a Vegetative; and a rational Soul, with more and more excellent, than a Sensitive: and therefore the *Life* which results from the Conjunction of either of these Souls with its proper Body, conveniently Organiz'd, must be accordingly different from the Life of the other two. Which *Aristotle* well understanding, first defines Life in general to be, *Animæ, ejusq; organici corporis, per conjunctionem & unionem utriusq; actus & Vigor*; and then teaches particularly, that Plants live by the Sole act of their vegetant Soul, namely by Nutrition; Brute Animals, by the Sole act of their Sentient, which includes the former; and Man by the act of Reason, or λογισμῶ, that is by Cogitation or Ratiocination, which as Supreme, præsupposes both Vegetation and Sension.

Let this Scale of Nature then be our Method. Let us, who have proposed to our selves to follow her steps, as near as our poreblind Reason shall permit us, ascend from the Life of Vegetation, to the Life of Sense; from the Life of Plants, to that of Animals, and among them, of the most perfect Animal, Man himself, who is our principal Subject. And that we may the more directly conduct our present inquiries by the clew of her observable operations, let us consider diligently (1) What Life is, (2) Whence it originally proceeds, (3) What is the Subject wherein it primarily Subsists, (4) how it is perpetually generated

ted a new, from the first moment of its accension, to that of its total extinction or period. (5) how it is continually diffused or Communicated from its Fountain to all parts of the Body.

But because the Fundament of right Ratiocination is placed in the true signification of Names, 'tis therefore requisite, that before I proceed to investigate the nature and formal reason of Life, I should recount and explain the various *Names* by which it hath been call'd: not only to prevent Ambiguity, by fixing their signification; but also in hope of gaining from them somewhat of Light toward my Disquisition.

From Holy Scriptures then I begin, both from the Veneration due to those Divine Oracles, and because they are of all Books whatsoever, most likely to afford me hints of the abstruse thing after which I am serching.

The Writer of the Book of *Genesis*, in the short History of Mans Creation (*Cap.* 2. *v.* 7.) expresses the manner of it in these Words, according to the Græc Text of the *Septuagint*. Καὶ ἔπλασεν ὁ θεὸς τὸν ἄνθρωπον, χοῦν ἀπὸ τῆς γῆς. Κὶ ἐνεφύσησεν εἰς τὸ πρόσωπον αὐτοῦ πνοὴν ζωῆς, καὶ ἐγένετο ὁ ἄνθρωπος εἰς ψυχὴν ζώσαν. Which the Vulgar Latin version renders thus. *Formavit igitur Dominus Deus hominem de limo terræ, & inspiravit in faciem ejus Spiraculum vitæ, & factus est homo in animam viventem*: and our latest Translation thus. "And the "Lord God formed Man of the Dust of the Earth, and "breathed into his Nostrils the Breath of Life; and "Man became a living Soul. Here then by πνοὴ ζωῆς *Spiraculum vitæ*, Life is signified: but whether the Author by those Words intimated or not, that God *kindled* Life in the Heart of *Adam* by a vital Breath blown by his Nostrils into his Blood, as fire is propagated by blowing; or whether he meant only, that *God gave*

to *Adam Life*, as some have interpreted them; is not for me, who pretend not to interpretation of sacred Writ, to determine. Nevertheless I hope I shall not be thought to usurp the Province of Theologues, if I take the innocent liberty of believing, that this admirable act of *Vivification* done by the Omnipotent Creator upon *Adam*, was done by way of *Inspiration*; by which, according to the genuine and proper Sense of the word, is to be understood, a blowing in of some subtil and energetic substance, into a place where before it was not, *viz.* into the Nostrils of the human Body newly formed of the Dust of the Earth. Which will perhaps be found somewhat the more reasonable, if the manner and circumstances of the miraculous *Revivification* of the good Shunamites Son, by the Prophet *Elisha* (*Kings* 2. *Cap.* 4.) be well considered. For, we read, that after the Prophet had layn some time, and much bestirred himself upon the Body of the dead Child, putting his Mouth upon his Mouth, and his Eyes upon his Eyes, and his Hands upon his Hands, and stretched himself again and again upon him; [διεθερμάνθη ἡ σὰρξ τοῦ παιδαρίου.] the Flesh of the Child waxed warm, and he Neesed seven times, and opened his Eyes. So that from thence it seems inferrible, that as the first Man was *inlivened*, so this Child was revived by Inspiration. Both acts doubtless were done miraculously, because by the same divine Agent, God: yet with this difference, that the former was performed immediately by God himself; the latter, mediately by his Instrument, the Prophet; to whose Breath blown into the Childs Mouth, and to whose Heat communicated to the Childs Flesh, and consequently to his Blood, the Author of Life was pleased to give a Virtue so Efficacious, as to restore and renovate the Vital motions of the Blood, Heart, Lungs, and

and Diaphragm of the Child, that had been ſtopped by the cold Hand of Death: and thoſe Motions being recommenced, and the Brain reinvigorated by a freſh influx of arterial Blood, replete with vital Spirits; by ſtrong contraction of its Membranes, as it were by a Critical Motion, expell'd the material and conjunct cauſe of the Diſeaſe, by Sternutation ſeven times repeted, before the Child opened his Eyes. For, that the Seat of that moſt acute Diſeaſe was in the Brain, is manifeſt even from the Childs complaint to his Father; [ τὴν κεφαλήν μȣ, τὴν κεφαλήν μȣ ] *my Head, my Head.* I am not ignorant, there are ſome, who expreſly affirm, that the word *inſpiration* is in ſacred Scriptures uſed only *Metaphoricaly*; whether truly or not, let Divines diſpute. Meanwhile I am certain, the word *Spirit*, upon which *inſpiration* depends, is in many places of the holy Bible uſed to expreſs Life. In Job. (*c.* 27. *v.* 3.) *quamdiu ſpiritus Dei eſt in naribus meis*, ſignifies, *ſo long as I ſhall Live*, or have Life. And in *Ezech* (*c.* 1. *v.* 20.) *Spiritus vitæ erat in rotis*, ſeems to me to ſay, *the Wheels were living*. Other Inſtances I might eaſily collect, if theſe were not ſufficient to my Scope, and if I were not obliged to haſten to other appellations and Characters of Life leſs liable to controverſy, and uſed by Philoſophers.

By *Hippocrates*, Life is *per periphraſin*, call'd ἔμφυτον πῦρ, *ignis ingenitus*; & ἡ ἐν τῇ καρδίᾳ τȣ̃ ψυχȣ̃ ἐμπύρωσις, *accenſio animæ in corde*, by *Ariſtotle*. The *Hebrews* expreſs it ſometimes by *nepheſch*, ſometimes by *neſchama*; both which words indifferently ſignifie *Soul*, or *Life*. The *Græcians*, whoſe Language is more copioſe, name it either ψυχὴ, which is derived ἀπὸ τȣ̃ ψύχειν, which ſignifies to *Breath*, or refrigerate by blowing; nor unfitly, becauſe to *Breath* or reſpire, is proper to living Creatures: or βίος *aliàs* βίοτος; or

ζωὴ;

ζωὴ; to which *Hesychius* addeth περιωσία. The *Latines*, commonly *Vita*; which is deflected from the Græc βιοτὴ, by cutting off the Vowel ὸ, and changing *b* into *v*, as is usually done; and sometimes *Anima*, which is from ἄνεμος, which signifies Wind; an Etymology owned by *Horace* himself in this odd exprssion of his, *Impellunt animæ lintea Thraciæ*; *in Carmin lib.* 4. *Ode* 12. and before him by *Lucretius* (*lib.* 6.) in these Words;

*Ventus ubi, atq;* animæ *subitò vis maxima quædam*
*Aut extrinsecus, aut ipsa ab tellure coorta.*

Who often calls the Soul, *Ventum Vitalem.*

*FROM* the various Names, we come to some few *Notions* that eminent Philosophers have formed to themselves of Life; such as among many others, seem to me more memorable than the rest, as well for the credit they have obtained in the Schools, as for the great renown of their Authors.

*Cardanus* (a man of admirable Subtility of Wit, in his lucid intervalls) defines Life to be, the *Operation or action of the Soul:* and (as *Jul. Scaliger, in Exercit.* 102 *Sect.* 5. not without Signs of envy, observes) hath therein many Followers. In the number of whom I must not list my self. (1) because if Life be an action of the Soul, the Body cannot be truly said to live. (2) if Life be an action, there must be an action of an action; for the actions of Life in Man, are (as *Arist.* 2. *de anima*, truly teaches) to understand, to have Sense, to move voluntarily, to be nourished, to speak, *&c.* and to suppose an action of an action, is manifestly absurd. In this point therefore I declare my self to be no disciple of *Cardans.*

*Fernelius* (equal to *Cardan* both in time and fame, nor

nor inferior in Sagacity of Spirit ) defines life thus; *Est Animantium vita, facultatum actionumq; omnium conservatio.* But this definition is too narrow for the thing, as taking no notice of the Body, which yet is participant of Life, and upon whose Organs the exercise of all the faculties and actions of the Soul depends. *Lib. de animæ facultat. cap. 26*

*Ludovicus Vives* describes Life to be, *Conservatio instrumentorum, quibus anima in corpore utitur:* because ( saith he ) when the instruments are corrupted, life ceaseth. But neither in this description is it safe to acquiesce. ( 1 ) because Life is conserved, not so much by the integrity of the Instruments, as by the Faculties, which are before the Instruments, and upon which all the Functions proximly depend. ( 2 ) The conservation of the Instruments doth not make or constitute Life, but rather follow it, as an effect. ( 3 ) if Life were only the conservation of the Instruments, then would it necessarily follow, that part of Life is lost or destroyed, when any of the Instruments are corrupted or cut off: which is absurd; life being indivisible, and daily experience attesting, that one or more of the Organs of the Body, as Hands, Feet, *&c*, may be cut off, without diminution of Life. Which even *Lucretius* himself acknowledged in these elegant Verses.

*At manet in vita, cui mens animusq; remansit,*
*Quamvis est circum-cæsis lacer undiq; membris:*
*Truncus, ademptâ animâ circum, membrisq; remotis,*
*Vivit, & ætherias vitaleis suscipit auras &c.*
*Lib.* 3.

Neither of these three Select Definitions proving in all points absolute and Scientific; some here perhaps expect, that I, who am so bold as to reject them, should

dare

dare also to substitute in the room of them, some new one of my own excogitation, if not more perfect, yet at least less culpable. To these expecting Gentelmen therefore I say, that much less of skill and strength being required to demolish, than to build; a Pigmy may be able to pull down, what Giants have raised; and that to form a true and complete definition of any the most obvious thing in Nature, much more of Life, which is extremly abstruse, would puzzel a much stronger Brain than mine. Well then may I be excused, if conscious of my imparity to a task so desperate, I forbear farther to expose my weakness by attempting it: and choose rather to leave them to collect, what my sentiments are of the nature of Life, from my following discourse.

*WHICH* being designed only as a modest disquisition of the natural causes of *Human Life*, I professedly pass by what that over-curiose nation of *Scholemen*, impensly addicted to notions abstracted from all commerce with the Senses, and to Speculations Metaphysical, have delivered of the Life of *Spirits*, of *Angells*, *Dæmon's*, and other *Beings* of that kind, subject neither to the Laws of Nature, nor to the Empire of Fate. And this I do, because some of their Doctrines far transcend the capacity of my narrow Wit, others seem more fine than useful, and all are remote from my present institute.

I omit also what our equaly acute *Dr. Glisson* hath with admirable subtility of Wit, and immense Labour of Meditation excogitated, and not many Years before his Death, divulged, of the *Energetic Life of Nature*, and its Faculties; by virtue of which he supposed, that even the most minute particles of this aspectable World do naturally perceive, desire, move themselves with Counsel, and (what is yet more wonderful) frame Bodies for themselves to inhabit, animate or inform them, and

and perform other most noble operations. Which I do, not only because this opinion, how favorable soever, hath not yet been received as canonical by common assent of Philosophers; but also because I humbly conceive it to be in all things (the Name only excepted) the same with that antique *Dogma* first delivered by *Plato*, and after asserted by his Followers, that all things in the Universe are *Animate*, that is, are naturally endowed [ἀισθεσει καὶ αὐτοκινησια] with *Sense* and *Self-motion*; which hath been sufficiently impugned by *Aristotle*, *Lucretius*, *Gassendus*, and all others, who have refuted *Plato's* Doctrine *de Anima mundi*, upon which it is grounded. Not that I reject this opinion of natural Sense, or Perception attributed to all things, but that I am not yet convinced of the truth of it: *&, Insipientis est, aliis dogmata illa aut commendare, aut convellere, de quorum veritate ipsemet adhuc dubitat.* And well may I suspend my assent to this opinion, which gives to things inanimate such Faculties, which my Philosophy will not grant to any but rational Creatures. Nor indeed would either *Lucretius*, or *Des Cartes*. For the *former*, though, according to the *Epicurean Hypothesis*, which he in all things followed, he attributes to *Atoms* (or as he calls them) *Solida Primordia rerum, a Spontaneous Mobility*; nevertheless denies, that they are naturally moved with *Knowledg* or Design, in these Verses. (Lib. 2.)

"*Nam neq; consilio debent tardata morari,*
"*Nec perscrutari primordia singula quæq;,*
"*Ut videant, qua quidq; geratur cum ratione.*

And the *Later*, in one of his Epistles to *Mersennus* (*Epistol. parte* 2. *epist.* 44.) where he strictly examines the Doctrine of a certain *Monk*, that ascribed to even

the most minute particles of Matter, a Power of moving themselves, and other ingenite propensions (the very same, I guess, with those supposed to be inseparably conjoyn'd with *Natural Perception*) plainly declares his Judgment of the unreasonableness thereof, in these Words. *Non probo indivisibilia ista, neq; naturales, quas illis tribuit, propensiones; istiusmodi enim propensiones absq; intellectu concipere nequeo, & ne irrationalibus quidem animalibus tale quidquam tribuo: Sed quicquid in illis appetitus, aut propensiones vocamus, per solas Mechanicæ regulas explico.*

These two præliminary Advertisements premised, I come into the direct way of my intended disquisition. That the *Life* of *Man* doth both originally spring, and perpetually depend from the intimate conjunction and union of his *Reasonable Soul* with his Body; is one of those few Assertions in which all Divines and natural Philosophers unanimously agree. And they have reason. For, while the rational Soul continues in the Body, so long Life continues; and when the same is separated from the Body, in that very moment of Time, Death succeeds.

Now this rational Soul being by most wise Men granted to be a pure *Spirit*, or substance merely Spiritual; it is from thence necessarily consequent, that the *Life* of it is *Substantial*, that is, the very substance of it, considered (as Metaphysicians love to speak) *non in ordine ad esse per se, sed in ordine ad operationes*. For, we dull-brain'd Mortals, to whom it is not granted, to be able to conceive the nature of Beings purely *Spiritual*, by notions adæquate to it; according to the Module of our understanding, distinguish even in *Angels*, their *subsistence Fundamental*, from their *Energetic Nature*: although in reality both are the same substance, but diversly considered. For, this substantial Life, though it may be, as to its Operations, by the same Divine Power

Power that gave it, ſuſpended; cannot yet be wholly taken away, ſo, as that it ſhould after continue to be a Spirit. Becauſe if a Spirit be ſuppoſed to be deprived of Life, the very ſubſtance of it muſt alſo be ſuppoſed to be at the ſame time *annihilated*. For, who can conceive ſo groſs a contradiction, as a *dead Angel*? The ſame may be as truly ſaid alſo of a *Rational Soul*, which is allowed to be a *Spirit* too. Wherefore the *Life* of it is (as I affirmed) *Subſtantial* and *Eſſential*, and conſequently incapable to be taken away, unleſs the Soul or Spirit it ſelf be at the ſame time annihilated. Which the Omnipotent Creator can indeed, when he ſhall ſo pleaſe, do: but it doth not appear from any place of holy Scripture, that he either hath done, or ever will do it: and therefore let no man doubt of the *Immortality* of his Soul.

*Sic etenim lethi præcluſa 'ſt janua menti.*

From this our fundamental poſition then, that the Life of a Man is in his rational Soul eſſentially; it follows of neceſſity, that the ſame Life cannot be in his Body too eſſentially, but by way of *Participation* or Communication. Nor is it difficult to conceive in our mind, that the Life of the Body, being ſeparable from it, is only communicated to it, or derived from another thing of a different Nature. For, if a ſubſtance eſſentially living, be intimately united to another ſubſtance of its own nature void of Life; the thing compoſed of thoſe two ſubſtances ſo united, muſt have Life: but ſo, that the firſt part live *ſubſtantially* or by virtue of its Eſſence; the other, only by *participation* of that eſſential Life. Certain therefore it is and evident, that the *Life* of a *Man* comes immediately from, and depends upon the *Preſence* of his *rational*

*Soul* in his Body. Which is the Truth we ſought after. May, *immediately*; becauſe the Life of the Soul is originally from God, who created it a living Subſtance.

Of the Souls of *Brute* Animals, the ſame may not be affirmed. For though it be true indeed, that their Souls alſo are the Principle or Fountain whence Life is communicated to the Bodies they inform; yet 'tis equally true, that theſe Souls being Material or Corporeal, their Life cannot be eſſential to the matter, of which they are compoſed, but flows from, and depends upon the determinate Modification of that matter, from which their Souls Reſult. So that in Brutes, as it is the Mode or manner of the diſpoſition of the Matter, not ſimply the matter it ſelf, that conſtitutes the Soul: So it is the Hypoſtaſis or ſubſiſtence of the ſame Mode, upon which alone the Life, that is, the Act, Energy and Vigor of the Soul depends. No wonder then, if we believe the Souls of all Brutes to be by their nature Mortal, and to be actually diſſolved, together with their Bodies, by Death.

That I may explain what I underſtand by the *Modification* of the matter which is here ſuppoſed to conſtitute the Soul of a Brute; give me leave, in this place to make a ſhort halt (for it is not a digreſſion) while I briefly declare what my ſentiments are concerning the Souls of Brutes.

I humbly, and with Submiſſion to wiſer Heads, conceive (1) That the diverſity of kinds obſerved among Brutes, proceeds immediately from the divers Modifications of the common matter of their Souls, and the reſpectively divers Organizations of their Bodies: from both which by admirable artifice conjoyned and united into one complex Syſtem or Machine, various faculties and proprieties muſt of neceſſity reſult, by which thoſe ſeveral kinds are among themſelves diſtinguiſhed.

guiſhed. (2) That the Specific or determinate Modification of the Soul, and reſpective Organization of the Body, in every diſtinct kind; is to be wholly attributed to the *Plaſtic virtue* or formative Power innate and affixed to the Seed of the Generants. (3) That this *Plaſtic virtue* is originally founded in the ſtill efficacious *Fiat* pronounced in the act of Creation, by the Divine Architect of all things: who commanding all Animals to increaſe and multiply, gave them at the ſame time power to fulfill that Command, by endowing their Seed with an active Principle to form, and impreſſing upon that Agent, a certain idea or exemplar, according to which it is obliged and directed how to form, and not otherwiſe; provided the Matter upon which it operates, be obedient and ſuſceptible of that Idea. So that the Idea firſt conceived in the Divine Intellect, and then preſcribed as a Pattern to the Plaſtic Spirit, with which the genital matter is impregnated; being not in all kinds, nay not in any two kinds of Animals one and the ſame, but a peculiar Idea aſſigned to each kind: it comes to paſs, that the Plaſtic Spirit thus directed, regulated, and confined by the Law of Nature, doth out of that genital matter form the Soul, and Organize the Body of every Brute Animal of any one of thoſe numerous kinds, exactly according to the prototype of that kind. And by this means I conceive all Brutes to be generated, both Soul and Body; and their diſtinct Species, without confuſion, or innovation, conſerved throughout all ages.

If I conceive amiſs, be pleaſed to conſider, that many excellent Wits, treating of the ſame Subject, have done ſo before me; and that the Theorem it ſelf is ſo abſtruſe, that, as *Cicero* (2. *Tuſculan.*) ſaid of the various Opinions of Philoſophers about the nature of a Soul, *Harum Sententiarum quæ vera ſit, Deus aliquis viderit;*

*derit; quæ verisimillima, magna quæstio est*: so may I say, Man may dispute, what is most probable, but God alone knows what is true, concerning the Souls of Beasts, and their production.

Notwithstanding this darkness of my way, I must adventure to go a little farther in it, and endevor to explain (1) What the *Substance* of a *Sensitive* Soul is, or of what Particles it is contexed; (2) In what the *Life* or Act and Vigor of it consisteth; and (3) What are the primary *Functions* and *Operations* of it.

As to the *First* then, it seems highly probable, that a *Sensitive* Soul is not a pure Spirit (such as the rational Soul of Man is) but a meer *Body*, yet a most subtile and extremely thin one, as being context of most minute and most subtile Corpuscules or Particles. For, if it were *Incorporeal*, it could neither act, nor suffer in the Body which it animate's or informs: not *Act*, because it could not touch any part; not *Suffer*, because it could not be touch't by any part of the Body. But that it doth both act and suffer in the Body, is most evident from its Sensations of external Objects, from its affects or Passions consequent to those Sensations, from the motions it causeth in the Members respective to those Passions, and from its Union and consension with the Body in all things. I call it therefore a *Body*, and say, that it is composed, or by an admirable contexture, made up of *most thin* and *most subtile* Particles, such perhaps as are most smooth and most round, like those of Flame or Heat: because otherwise it could not diffuse it self so swiftly through, nor cohere within with the whole Body and all parts of it; and because when it departs out of the Body, the Body is not perceived to lose any the least thing of its former Bulk, Figure, or Weight; no more than a Vessel of Wine loses by the exhalation of its Spirits, or a piece of Amber-Grise

loses

loſes by emiſſion of its Odor. So that we may imagine, that if the whole ſenſitive Soul of an Elephant were conglomerated or condenſed, it might be contained in a place no bigger than a Cherry-ſtone.

Theſe conſtituent particles or Elements of a Senſitive Soul, I ſuppoſe to be for the moſt part analogous to the nature of *Fire*: becauſe the natural heat of all Animals comes from the Soul, and their Life conſiſteth in that Heat.

I alſo ſuppoſe them to be at firſt conteined in the *genital matter*: the moſt ſpirituoſe or active particles of which are in the act of formation, by the Plaſtic Virtue Selected, Diſpoſed, Formed, and as it were contexed into a little Soul; and the *groſſer* or leſs agil framed by degrees into an organical *Body* of competent dimenſions, and of Figure anſwerable to the Specific Idea by the Divine Creator pre-ordained and aſſigned to that Species, to which the Generants belong. And this I ſuppoſe, becauſe the brisk, vigorous and ſwift motions of the Soul in the Body, require it to be compoſed of particles moſt ſubtile and active; and becauſe as well the Soul, as the Body, is by all Philoſophers granted to be formed of the ſeminal matter; and becauſe otherwiſe Brutes cannot be properly ſaid to generate their like *in Specie*, and by conſequence, the Power to that end entailed upon them, by the firſt and univerſal command of God, *increſcite ac multiplicamini*, would be rendr'd of no effect.

I farther ſuppoſe, that this Embryon Soul after this manner newly formed, or as it were kindled, is dayly *augmented*, by acceſſion and aſſimilation of like Particles, as the Body is augmented out of the groſſer and leſs fugitive Parts, of the Aliment: till both Soul and Body have attain'd to the ſtandard of Maturity, or perfection of growth; thenceforth ſlowly declining in Vigor,

gor, by degrees answerable to those of their ascent, till they arrive at their final Period, Death, which dissolving the system or contexture of the Soul, leaves the Particles of which it was composed, to fly away, and vanish into Aire; and the Body to be resolved into its first Principles, by slower corruption. For, Nutrition and Augmentation are (as yesterday I proved) Operations of the Plastic Virtue continually reforming the whole Animal: and the duration or subsistence of the Soul is the *Vinculum* of the whole composition or concretion. So that the Soul may be, by an apposite Metaphor, called the *Salt* or Condiment that preserves the fleshy parts of the Body from putrefaction; as the Spirits of Wine preserve the whole Mass of Liquor through which they are diffused, from losing its Vigor and generose quality: and according to that oraculous saying of *Hippocrates*, ψυχὴ ἀεὶ φύεται μέχρι θανάτου, *the Soul is always generated anew till Death.* Which very thing is argument enough to evince, that if it be not really a most thin Flame, finer and more gentle than that arising from the purest Spirit of Wine burning within a paper Lantern, it is at least very like to Flame. For, as this, so that is every moment regenerated, at once perishing and reviving: perishing by continual dissipation of some Particles, and reviving by continual accension of others out of its proper aliment; the more subtile and sulphureous Particles of the Blood serving to repair the decays of the Soul, as the grosser Particles of the *succus nutritius* are convenient to recruit the exhausted substance of the Body. So that it was not without reason, that *Democritus*, *Epicurus*, *Lucretius*, and *Hippocrates*, among the Antients; and among the Moderns, *Fernelius*, *Heurnius*, *Carteſius*, *Hogelandus*, *Honoratus Faber*, and *Dr. Willis*, held the Soul of a Brute to be of a *fiery* substance: and that *Aristotle* himself

himself called it πῦρ νοερὸν; and that the *Ld. Chancellor Bacon* (*natural Hist. centur.* 7.) makes one of the two radical differences between Plants and Animals, to consist in this, that *the Spirits of living Creatures hold more of Flame.*

Finally I conceive, that this sensitive Soul, however it be a thing mixt or composed of Particles among themselves in Magnitude, Figure, Position, and Motion somwhat various, is notwithstanding by admirable Artifice so constituted, and the parts of it so contemperate and context, that it is made one most *thin*, and yet *continued* and *coherent* substance, diffused through the whole Body. Nor can its component Particles, while it subsists in the Body, be dissociated (otherwise than by their own evolation, which is instantly supplied by the accession and unition of others) no more than the natural smell, colour, or tast can be separated from an Apple, Peach or any other Fruit. This universal *diffusion* of it through the Body, is what the *Ld. Chancellor Bacon* calls, *Branching* of the Spirits (in *Nat. Hist. Cent.* 7. *Paragraph.* 1) where he saith, *the Spirits of things Animate are all continued with themselves,* and *branched in Veins and secret Canales, as Blood is*; and what *Dr. Willis* calls, *Coextension* of the Soul to all parts of the Body. Granting then, that this most thin, continued and diffused Substance is conteined in the Body, and as it were coherent with the same, thereby sustained and bounded; we may with the more probability conceive, that it is to the Body the cause of all the Faculties, Actions, Passions, and Motions belonging to its Nature, as the Organ of such a Soul; that it keeps the Body together, at once both conserving, actuating, managing and governing it; and that it can be no more separated from the Body, without the dissolution thereof, than the Odor can be separated

from Frankincense, without destroying the nature of it. And this I think sufficient to explain what I conceive of the *first* quæstion proposed, *viz.* of what *Substance* the Soul of a Brute is, and of what *Particles* composed.

As to the *Second, viz. wherein the* Life *of such a Soul doth consist*; it seems to me probable, that since Life, according to the general notion of it, is nothing but *Usura quædam vigoris, mobilitatisq; facultatum activarum ejus rei, cui inest*; the Life of a sensitive Soul is immediately founded in a certain *Motion* of the active and spirituose Particles of which it is composed: as the Life of an Animal consisteth in the continuation of the same determinate Motion of those Spirits, by which it was at first kindled; and of the actual exercise of the Faculties that emerge or result from the union of the Soul with its Body, by the Fabrick of the various Organs thereof adapted to perform all the various Functions, Offices and Actions requisite to consummate the nature of such an Animal *in Specie*. What kind of Motion that is, in which, as in its Origine, I conceive this Life to be founded; I shall by and by declare, when I come to enquire what is the immediate *Subject* or Seat of Life; having first endeavor'd to solve the

*Third* Question proposed, *viz. what are the principal Faculties and Operations of a sensitive Soul.* These then are (as ye well know) all comprehended in *Life*, *Sense*, and motion Animal: of which I shall here consider only the *Second*, reserving the *First* till by and by, and the *Last* till the Clew of my method hath brought me to treat of it in its proper place.

As to the Faculty of *Sense* therefore, which constitutes the chief difference between living Creatures and things inanimate, which *Lucretius* elegantly call's *animam ipsius animæ*, and the extinction or total privation

tion of which is Death; since I have supposed a sensitive Soul to be *Material* or Corporeal, I must seek for this noble Power, whereby she is qualified, not only to perceive external Objects, but to be also conscious of all her Perceptions, in *Matter* after a certain peculiar manner, so or so disposed or modified; and in nothing else, lest I recede from that supposition. But in what matter is it most likely to be found, whatsoever the determinate modification requisite to create such a Power shall at length be imagined to be: in the Matter of the *Soul* herself, or in that of the Body she animates. Truly, if we distinctly examine either the Soul or Body of a Brute, as not conjoyned and united into one *Compositum*; we shall have a hard task of it, to find in either of them, or indeed in any other material Subject whatsoever, any thing to which we may reasonably attribute such a Power of *perceiving* and *self-moving*. But, if we consider the *whole* Brute, as a Body animated, and by Divine Art of an infinite Wisdom designed, framed and qualified for certain actions, Uses and ends: then we may safely conclude, that a Brute is, by the law of the Creation or institute of Almighty God, so made and comparated, as that from such a Soul and Body united, such a confluence of Faculties should result, as are necessary and convenient to the uses and ends for which it was designed. Do but convert your thoughts awhile upon *Mechanic Engines*, and seriously contemplate the motions, powers and effects of them. Composed they are all indeed of gross, solid and ponderose Materials; and yet such is the designe, contrivance and artifice of their various parts, as that merely from their Figures, positions and motions of them conjoyn'd into one complex Machine, there do necessarily result certain and constant operations, answerable to the intent and scope of the Artists, and far transcend-

ing the forces of their divided ingredients. Before the invention of Clocks and Watches, who could expect, that of Iron and Braſs, dul and heavy Metalls, a Machine ſhould be framed; which conſiſting of a few Wheels indented in the circumference, and a Spring commodiouſly diſpoſed, ſhould in its motions rival the Celeſtial Orbs, and without the help or direction of any external mover, by repeted revolutions, meaſure the ſucceſſive ſpaces of Time, even to Minutes and Seconds, as exactly almoſt as the revolutions of the Terreſtial Globe it ſelf? And yet now ſuch Machines are commonly made even by ſome Black-Smiths, and Mens admiration of their pretty artifice long ſince ceaſed. If then in vulgar Mechanics, the contrivance and advantagious diſpoſitions of matter, be more noble and efficacious than matter it ſelf: certainly in a *living Automaton* or Animal conſiſting of an active Soul and organic Body intimately united, the Powers emergent from the force of ſuch a Soul, and from a conſpiracy and cooperation of ſo many, and ſo various Organs, all ſo admirably formed, ought to be eſteemed incomparably more noble, more Energetic. If the art of *Man*, weak and ignorant Man, can give to Bodies, of themſelves weighty, ſluggiſh and unactive, figure, order, connexion and motion fit to produce effects above the capacity of their ſingle Natures: What ought we to think of the Divine art of the Creator, whoſe *Power* is infinite, becauſe his *Wiſdom* is ſo? *Cùm magnes (cui* Thales *propterea animam attribuit) ferrum ad ſe attrahit, domitrixq; illa rerum omnium materia (ut ait* Plinius, l. 36. c. 16.) *ad inane neſcio quid currit; & acus ferrea eidem affricta, mundi cardines perpetuò reſpicit: cùm horologia noſtra ſingulos diei noctiſq; horas conſtanter indicant: an non corpus aliud (præter elementa) idq; divinius participare videntur? Quòd ſi ex* artis *dominio*

*minio & gubernatione, tam præclara quotidie ſupra rerum ipſarum vires efficiantur; quid ex* Naturæ *præcepto ac regimine fieri putabimus, cujus ars ſolùm imitatrix eſt? Et ſi hominibus ſerviendo, tam admiranda perficiant; quid, quæſo, ab iis expectabimus, ubi inſtrumenta fuerint in manu* Dei? Harv. in lib. de generat. Animal. exercit. 70. Could not He, think ye, who by the voice of his Will call'd the World out of *Chaos*, and made ſo many myriads of diſtinct beings out of one and the ſame univerſal Matter; could not He, I ſay, when he created Brutes, ſo faſhion and organize the various Parts and Members of their Bodies, thereto adjuſt the finer and more active contexture of their Souls, and impreſs ſuch motions upon them, as that from the union and cooperation of both, a ſyndrome or confederacy of Faculties ſhould ariſe, by which they might be qualified and inabled to live, to perceive, to know their perceptions, to move and act reſpectively to the proper ends and uſes of their Creation? Undoubtedly He could; and 'tis an Article of my belief, that He did.

When ye hear a *Church Organ*, is it not as delightful to your Mind, as the Muſick is to your Ear, to conſider how ſo many grateful Notes and Conſonances, that compoſe the charming Harmony, do all ariſe only from Wind blown into a ſet of Pipes, gradually different in length and bore, and ſucceſſively let into them by the apertures of their Valves? and do ye not then obſerve, the effect of this artificial inſtrument highly to excell, both the Materials of it, and the Hand of the Organiſt that play's upon it? The like Harmony perhaps ye have ſometimes heard from a *muſical Water-Work*, that plaid of its ſelf, without the Fingers of a Muſician to preſs down the Jacks, merely by the force of a Stream of Water opening and ſhutting

ting the Valves by turns, and in an order predesign'd to produce the harmonical Sounds, Consonances and Modes requisite to the composition, to which it had been set.

Now to this *Hydraulic Organ* ye may compare a Beast, whose Soul being indeed, by reason of a certain *modification* of her matter, qualified to perceive the various impressions made by objects upon the Nerves of the instruments of the Senses; and to perform many trains of Actions thereupon: is yet so limited in her Energy, that she can perform no other actions, but such as are (like the various parts of an harmonical Composition) regularly prescribed (as the Notes of a Tune are prict down on the tumbrell of our Instrument) by the Law of her Nature, and determined for the most part to the same scope, the *Conservation* of herself and the Body she animates. So that she seems qualified only to produce a Harmony of *Life*, *Sense* and *Motion:* and this only from a certain *contexture* of the spirituose Particles of the matter of which she is made, and from the respective *Organization* of the Body in which she acts.

But from what kind of *texture* or *modification* of the supposed Particles, doth the faculty of *Perceiving* or discerning Objects arise? For, what I have hitherto said, is too general to explain the particular reason of the thing here inquired, *viz. qua ratione fiat, ut res sentiens creetur ex rebus insensilibus*; whence it is, that a corporeal Soul, composed of matter in it self wholly void of Sense, acquires the power of Sensation.

I say therefore, that this is indeed the difficulty that remain's here to be solved: but such a difficulty, that I dare not attempt to solve; having much more reason to believe, that it will to the end of the World remain *indissoluble*. For, to comprehend, what particular

*Mode*

*Mode* of compoſition or contexture of *inſenſil Matter*, that is, that gives to it the nature or eſſence and faculties of a *ſenſitive Soul*; ſeems to me far to tranſcend the capacity of human underſtanding: and whoſoever ſhall with attention and Judgment read what that moſt acute, and no leſs profound Philoſopher, *Gaſſendus* hath written on this Ænigmatic Queſtion, *Qui ſenſile gigni ex inſenſilibus poſſit?* (*in lib.* 10. *Diogen. Laertii*) will (I preſume) with him conclude, *Hanc rem videri omni humanâ perſpicaciâ, & ſagacitate ſuperiorem.* Leaving then this Problem, as I found it, deſperate; and ending the halt I, with your permiſſion, made, to conſider the nature, Life and Principal Faculties of a ſenſitive Soul: I proceed to the *THIRD* capital Enquiry deſigned in this diſcourſe. ¶

*WHAT* Opinions I at preſent hold to be moſt probable, as well concerning the nature of Life in general, as touching the different origines of Human, and Brutal Life in particular; ye have with obliging patience heard. Be pleaſed with like patience to hear alſo what I have to ſay, concerning the *SUBJECT* wherein the Life both of Man and Brutes ſeems primarily to *Subſiſt*.

That the Life of all Animals is originally as it were kindled in their *Blood*, we may learn from the wiſeſt of Men and Kings, *Salomon* himſelf. Who in his Book of *Wiſdom* (*Cap.* 2. *v.* 2. according to the Græc verſion of the LXX Interpreters) introduceth impious Men diſcourſing among themſelves of the ſhort, incertain and eaſily extinguiſhable Life of Man, in this manner; ὅτι καπνὸς ἡ πνοὴ ἐν ῥισὶν ἡμῶν, καὶ ὁ λόγος σπινθὴρ ἐν κινήσει καρδίας ἡμῶν; *quoniam fumus eſt afflatus in naribus noſtris, & ſermo ſcintilla in motu cordis noſtri*; which our laſt Tranſlators have thus engliſhed; *for the Breath*

*Breath in our Noſtrils is as Smoke, and a little Spark in the moving of our Heart.* For if by καπνὸς ἡ πνοὴ, & ὁ λόγος, *Life* be underſtood; we may from this remarkable text ſafely infer, that *Salomon* was not far from holding the ſame Opinion concerning the Fountain or Origine of Life, that is aſſerted by all our modern Anatomiſts, *viz.* that *Life firſt ariſeth from, and is perpetually as it were kindled anew by the motion of the Blood:* though it be ſcarce probable, he had any the leaſt knowledg of the perpetual *Circuition* or *Circulation* of the Blood, firſt diſcovered to the World by our thence immortal *Dr. Harvey.*

And by one infinitely greater than *Salomon*, even by the Author of Truth, and giver of Life, *God* himſelf, we are certainly taught; that the Life of all Animals, of what kind ſoever, is ſeated primarily, and doth continually ſubſiſt in the *Blood*, *tanquam in ſubjecto ſuo primordiali*; or at leaſt in ſome certain humor analogous to Blood, and therefore not unworthy to be call'd a *vital* Humor. For (in *Levit. cap.* 17. *v.* 14.) He ſaith expreſly, Αἷμα πάσης σαρκὸς οὐ φάγεσθε, ὅτι ἡ ψυχὴ πάσης σαρκὸς αἷμα αὐτοῦ ἐστι: *Ye ſhall eat the Blood of no manner of Fleſh; for the Life of all Fleſh is the Blood thereof.*

Being then by Divine Authority aſſured, that Life is the Of-ſpring of the Blood, and perpetually reſident therein; we may with good reaſon diſtinguiſh Life into *Original*, and *Influent.*

The *Former* is that, which is perpetually as it were kindled in the Blood paſſing through the Ventricles of the Heart, not from the influx of any adventitious Principle, but by the Sole power and energy of the *vital Spirit* itſelf contained in, and ruling the Bloud. For, the *vital Motion* itſelf comes immediately from no other Principle but that ruling Spirit: and therefore

fore the *Act* of the same Spirit is, by consequence, *Vital*. And forasmuch as the reason of the actual *Heat* of the Blood, consisteth only and wholly in that vital *Motion*; that *Heat* also must be *Vital*, and the regent *Spirit*, that suscitates that motion, first in it self, and then in the Blood, must be the true Fountain and Origin of the *vital Heat*. This great truth certainly was not unknown to the Antients. For *Virgil* seems to more than hint it in that Verse of his (*Æneid. lib.* 10.).

*Una eademq; via sanguis animusq; sequuntur:*

And *Suidas*, where he saith, αἷμα, τὸ ζωτικὸν τοῦ ανθρώπου; also (as *Aristotle* relates) *Critias*, who held, *Sentire, maximè proprium esse animæ, atq; hoc inesse propter sanguinis naturam.* To these may be subjoyned *Thales Milesius*, *Diogenes*, *Heraclitus*, *Alcmæon &c.* who all consented in this position, *id animam esse, quod sua natura vim movendi obtineret.* Evident it is then, that this Doctrine, that the vital Spirit is the principle of motion or heat, and consequently of Original Life in the Blood, was taught by some of the antient Philosophers; though probably not so clearly and fully, as by the Anatomists of our Age, who have had the advantage to know the whole mystery of the *Circuition* of the Blood, whereof the former seem to have been ignorant.

Hence it appears, how far those of our late Writers have erred from the Truth, who permitting their Phantacy to overrule their Judgment, and indulging I know not what Chymical shall I say, or Chimerical Hypotheses drawn from the contrariety between *Alchali's* and *Acids*, have confidently taught, that Life ariseth from a conflict or Fight, of two Antagonists,

whether of an *Acid* or *Saline* and a *Lixivioſe*; or of a *Saline* and *Sulphureoſe*; or of the *Bile*, *Chyle*, or *nitroaereal* Spirit and the Blood. For, the *vital Motion* really proceeds (as I ſaid) from the very nature of the thing which cauſeth it; that is, in the Blood, from the vital Spirit regent of the Blood; which being naturally agil, active and votatil, and alwaies endevoring to extricate itſelf, neceſſarily contends with the groſſer parts that clogg and reſtrain it, and by that contention excites motion in the Blood, and ſuch a motion upon which the vitality of the Blood depends. Impoſſible therefore it is, that Life ſhould come to the Blood from a mutual conflict of extraneous or forein Principles, whatſoever they are ſuppoſed to be.

The *Later* or *Influent* Life is communicated from the Blood now impregnated with vital Spirits, to all parts of the Body. Of which much remains to be ſpoke in its proper place.

Meanwhile, that we may know what is to be underſtood *per curriculum vitæ*, the *race* or *cours* of Life; 'tis neceſſary for us to run through all the Uſes and Acts of the Blood, while it flows in a Circle to and through all parts of the Body. For, theſe being attentively ſurvey'd, will at laſt reward our diligence with Light enough to direct us to judge more clearly of the Power and Energy of as well Original, as Influent Life. But firſt (for perſpicuites ſake) we muſt advert, that *Arterioſe* Blood ſeems to differ from *Venoſe*, chiefly in this; that in Arterioſe Blood, the Heat or Motion Vital (for both are one thing, and ſo we ſhall by and by find them to be) is *actual*; in venoſe, only in the way or *diſpoſition* to become actual; as will appear from our following diſcourſe concerning the *Acts* of the Blood in the race of Life.

Which are accompted in number five, *viz.* (1) Actual

al Generation of Original Life, or of vital motion or heat in the Blood itself; (2) Excitation of the Pulse of the Heart and Arteries; (3) Distribution of the Blood by virtue of that pulsation; (4) Communication of Life to all parts of the Body, by means of that distribution; and (5) Reduction of arterioſe Blood to the state of Venoſe; the exhalations of it being first, partly consumed, partly condensed and absorp't into the Lympheducts. Of each of the Acts we must particularly enquire.

The *FIRST* Act, *viz.* the *Generation of Original Life in the Blood it self*, seems to be perform'd in this manner. The vital Spirit, rector of the Blood, by its own natural force and expansive energy endevors to exagitate and expand the Blood now again brought into the Ventricles of the Heart: while the grosser parts of the Blood, by their nature more sluggish and unactive, resist and hinder that endevor to expansion. From this resistence or checking, instantly arises a certain Colluctation or mutual striving between the expansive motion or endevor of the vital Spirits, on one part; and the renitency of the grosser parts of the Blood, on the other. And from this Colluctation, an actual *Heat* is quickly excited or kindled in the Blood: actual Heat being nothing else but an expansive Luctation of the Particles of the Body or Subject in which it is; as the illustrious Lord Chancellor *Bacon* hath with admirable sagacity, from many instances collected, *in historia calidi, in novi Organi Pag.* 218. Seeing therefore, that this motion of the Blood consisteth in the expansive endevor of the Spirits, and the reluctation of the other parts of it; this Motion, consequently is *actual Heat*. But, because this expansive Luctation is not hostil or noxious, but Amicable, Benign, and tending not only to the conservation of the Blood, but al-

ſo to the exaltation of all its Faculties and Operations; and becauſe it comes (as I ſaid a little before) from within, from the Spirit conteined in, and ruling the Blood: therefore the Motion or Heat thence reſulting, is alſo *Vital*. For in that very expanſive motion of the Blood, doth the formal reaſon of Life originally conſiſt.

This being a Theorem not a little abſtruſe, and of very great Moment, chiefly to Phyſicians; 'tis requiſite, I ſhould endevor both to clear and eſtabliſh it. That I may do ſo, I begg leave to ſet before you a ſhort Series or Train of certain *Propoſitions*; of which the ſubſequent depending (like the Links of a Chain) upon the antecedent, they may at length convince you of the Truth from thence to be concluded.

## PROPOS. I.

### *That Heat is only Motion.*

THe verity of this is apparent (1) From Flame, which is perpetually and violently Moved. (2) From the like agitation of all parts of fervent or boyling Liquors; (3) From the incitation and increment of Heat cauſed by Motion; as in blowing up Fire by Bellows or Winds: (4) From the very extinction of Fire and Heat by all ſtrong compreſſion, which arreſteth the Motion thereof, and inſtantly cauſeth it to ceaſe: (5) From hence, that moſt Bodies are deſtroyed, at leaſt ſenſibly altered by all Fire, and by ſtrong and vehement Heat; which introducing a Tumult, Perturbation, and rapid Motion upon their Parts,

parts, by degrees totally dissolves the cohesion or continuity of them. Nevertheless this Proposition is to be understood with due limitation, or as it stands for the Genus of Heat: not that Heat generates Motion, or that Motion generates Heat always (tho both these be in some things true) but that Heat it self, or the very essence of Heat is Motion, and nothing else; yet a certain peculiar sort of Motion, or limited by the differences to be subjoyned.

## PROPOS. II.

*That Heat is an Expansive motion, by which a Body strives to dilate it self, and recede into a larger space, than what it before possessed.*

THis also is evident (1) In Flame, where the Fume or Fat Exhalation manifestly widens itself, and spreads into Flame; (2) In all boyling Liquors, which sensibly swell, rise up, and emit Bubbles; still urging the process of self-dilation, untill they become more extense, and are turned into Vapor, or Smoke, or Aire; (3) In Wood and all other combustible matter set on Fire, where is sometimes an exudation of moysture, alwaies an evaporation; (4) in the melting of Metals; which being most compact Bodies, do not easily swell and dilate themselves; and yet the Spirit of them, being once excited by Fire, begins instantly to dilate itself, and continues to push away and drive off the grosser parts, till their coherence being interrupted, they become liquid: and if the Heat be more

and

and more intended, it dissolves and converts much of the fixed Metal into a volatil Substance; Gold only excepted: (5) in a Staff of Wood or Cane, which being heat in hot Embers, becomes easily flexible; a sign of internal dilatation: (6) In Aire above all things, which instantly and manifestly expands itself by a little Heat: (7) In the contrary nature of Cold; which contracts most Bodies, forcing them into narrower spaces, and shrinking their dimensions; so that in extreme Frosts, Nayls have been observed to fall out of Doors, and Vessels of Brass to crack, with many other admirable effects of great Cold, noted by the Honourable *Mr. Boyl* in his most accurate *History of Cold*. So that Heat and Cold, though they do many actions common to both, are yet *è diametro* contraries in this; that Heat gives a Motion expansive and dilating, but Cold gives a Motion contractive and condensing.

PROPOS.

## PROPOS. III.

*That Heat is a Motion expansive, not uniformly through the whole Subject, but through the lesser Particles thereof; not free, but checkt, hinder'd, and repulsed or reverberate: So that the Motion becomes imterrupt, alternative, perpetually trembling, and striving, and incited by that resistence and repuls.* Whence comes the Fury of Fire and Heat pent in and opposed in their Expansion.

OF this we have instances. (1) In Flame, boyling Liquors, melted Metals, glass Furnaces &c. all which perpetually tremble, swell up, and again subside alternately: (2) In Fire, which burns more fiercely, and scorches more ardently in frosty Weather: (3) in common Weather-glasses; in which when the Aire is expanded uniformly and equally, without impediment or repuls, no Heat is perceived: but if you hold a Pan of burning Coals near the bottom, and at the same time put a Cloth dipped in cold Water upon the top; the check and repuls thereby given to the expansion of the Aire, will cause a manifest trepidation in the Water, and intend the borrowed Heat of it. (4) In Winds pent in, which though they break forth with very great violence, so that their motion must needs be extremely rapid and dilating; do not yet from thence conceive any sensible Heat: because the motion is in all the particles of them equally,

ly, and proceeds uniformly, without check or interruption: whereas in the burning Wind, from thence called by *Aristotle* (*in Meteor.*) περισσὸς, great heat seems to be generated from the frequent repulses and repercussions of its rapid Motion, insomuch that it scorches where it blows; chiefly in narrow and deep Vallies, where it is kept in on both sides, and wheel'd about into eddies or Whirle-Winds. (5) In the very manner of *Ustion* or burning, which is always transacted through the minute Pores of the Body burnt; so that *Ustion* doth always undermine, and penetrate, and prick, as if it were done by the points of a great many Needles. Thence it seems to come also that *Aqua Fortis*, *Chrysulca* and other dissolving Liquors (if proportionate to the Body on which they act) do the work of Fire, by their penetrating, pungent, and corroding Motions.

## PROPOS. IV.

*That this expansive, repuls'd, alternative and penetrating Motion requisite to the generation of Heat, ought to be also rapid; and to be made by Particles, minute indeed, but not reduced to extreme subtilty.*

THe verity of this proposition may be collected (1) From a comparation of the works of *Fire*, with the works of *Time* or Age. For, Age dries, consumes, undermines, and incinerates, no less than Fire, yea far more subtilly: but because the motion that

that causes these effects, is both very slow, and performed by Particles extremely minute; therefore no sensible *Heat* is thereby produced. (2) from comparing the dissolution of *Gold*, with that of *Iron*; the first, in *Aqua Regis*; the other in *Aqua Fortis*. For Gold is dissolved calmly, without tumult or effervescence raised in the dissolvent: Iron, not without vehement excitation of Heat: probably because in Gold, the ingress of the Water of Separation is slow, mild, and subtilly insinuating, and the yeilding of the parts of the Gold easy; but in Iron, the ingress is rough, difficult, and with conflict, the parts of the Iron with greater obstinacy resisting the motion of the dissolvent. (3) From *Gangrens* and *Mortifications*; which invade and spread without inducing much either of heat or pain, by reason the motion of putrefaction is both slow, and performed by Particles extremely subtil; otherwise it would certainly cause Pain in the part affected.

Now from these Propositions (the three latter of which are certain necessary Limitations of the first) we may deduce this genuine conclusion; That *Heat is a certain Motion, expansive, checkt or repuls'd, striving, quickned or incited by opposition, perform'd by minute Particles, and with conflict and some impetuosity.*

Which to me (I declare) seems to be so perspicuous and convincing, that I dare promise, that if any man be able to excite a Motion tending to dilatation or expansion of the Movent, and then to repress that motion, so as the dilatation may not proceed equally and uniformly, but prevail and be repulsed alternately: he shall thereby most certainly generate *Heat* in the Body whose parts are so moved, of what kind or constitution soever the Body shall be. For, whether it be a Body Elementary (as they speak) or luminose or

opaque; rare, or denſe; locally expanſed, or contein'd within the bounds of its firſt dimenſions; tending to diſſolution, or remaining in its ſtate; whether it be Animal, Vegetable, or Mineral; Water, or Oyl, or Aire, or any other ſubſtance ſuſceptive of the Motion deſcribed; it will make no difference, as to the effect aimed at, the production of actual *Heat*.

Why then ſhould I not believe, that Nature hath inſtituted ſuch an actual Motion or Heat in the Blood of Animals, that Life Original might be therein perpetually generated: ſince to make that actual Heat alſo *Vital*, nothing more is required (as I ſaid before) but that it ariſe from an internal Principle or Mover, *viz.* the vital Spirits ingenite in the Blood; and that it be amicable, benign and placid, as in the State of Health it always is; and ſince both thoſe requiſite conditions or qualifications are found in the motion of the Blood? If in the aſſertion of the precedent Propoſitions, or in the deduction of my concluſion from them, I have from weakneſs of Judgment, admitted any Paralogiſm; I ſhall receive the diſcovery thereof as a ſingular favor from any man of greater perſpicacity, and more skilful in the art of reaſoning rightly, and will ingenuouſly acknowledg and retract my error. Meanwhile I acquieſce in this perſwaſion, that the vital Heat of Animals, is an expanſive Motion of the Spirits of the Blood, ſomewhat checkt or repulſed, but ſtill endevoring with ſufficient force, and alternately prevailing: which I owe, partly to the Ld. Chancellor *Bacon* (*in novo Organo, ubi agit de prærogativis inſtantiarum, in vindemiatione* 1.) partly to his equal ſectator, *Dr. Gliſſon*, who had the felicity to improve whatſoever he had borrowed, and to raiſe illuſtrous Theories from obſcure hints.

But hold a little, and give me ſpace to reflect upon what

what I have lately said. Have I not in this place incurred the danger of being accused of contradicting myself? 'Tis not half an Hour since I declared my assent to that common Doctrine of all Theologs, and most Philosophers, that the Life of a Man doth originally spring from, and perpetually depend upon the union of his rational Soul with his Body. And now I affirm, that the Life of all Animals (Man himself not excepted) consists in the expansive motion of the Spirits in their Blood. Are not these two assertions to be numbred among ἀσύστατα, things inconsistent, yea manifestly repugnant each to the other? If either of them be true, is not the other necessarily false?

To obviate this formidable accusation, I say; that these two positions, though seemingly opposite, are yet really capable of reconciliation each to the other; and by consequence, both may be true. For (1) well known it is to all versed in the Jewish Commentaries upon the *Pentateuch*, that the most learned *Rabbins*, interpreting these words in the History of Mans Creation; *Deus inspiravit in faciem hominis spiraculum vitæ*; to shew the excellency of Man above all his fellow Creatures, give this Paraphrase upon them: *Homini Deus in creatione imaginem suam indidit, & inspiravit halitum vitæ duplicis, mortalis & immortalis.* So that according to the Sense of this Paraphrase, at least if I understand it rightly, God was pleased to give to Man a *double* Life, not two lives successive, one before Death, the other after; but two *conjoyn'd* in the Body: one *Immortal*, which can be no other but that which is essential to the rational Soul, and communicated to the Body, by virtue of the intimate union of those two so different substances; the other *Mortal*, common to Brutes also, and extinguishable by death, which I deduce from the expansive motion of the Spirits of the

Blood. Nor hath this interpretation of the *Jewish* Doctors been (for ought I know) rejected by the *Christian* Scholes, as unsound, much less as Heretical: and therefore I humbly conceive, it is not unlawful for me to embrace it.

(2) That in this Life, every individual Man hath also *two* distinct Souls; one *Rational*, by which he is made a reasonable Creature; the other, *Sensitive*, by virtue of which he becomes a Sensitive Animal: and that these are coexistent, conjunct, and cooperating in him, untill death, which delivers the *first* into a free injoyment of her essential immortality, but dissolves the *latter* into the Elements or matter, of which it was composed; is an opinion very antient, highly consentaneous to reason, and defended, not only by many eminent *Philosophers* as well antique as modern, but even by some *Divines* of great learning, Piety and Fame; among whom I need name only *Gassendus*, of the Roman, and *Dr. Hammond*, of our Church. The *former* of which hath professedly asserted it *in Physiologia Epicuri, cap. de Animæ sede*: the *other* in Notes on the 23. *Verse of the* 5 *Chap. of* St. Pauls *first Epist. ad Thess.* Where interpreting these Words of the divinely inspir'd Author; τὸ ὁλόκληρον ὑμῶν τὸ πνεῦμα, καὶ ἡ ψυχὴ, καὶ τὸ σῶμα, *integer vester spiritus, & anima, & corpus* &c; he conceived, that the Apostle divides the whole Man into his three constituent parts, *viz.* the *Body*, which comprehends the Flesh and Members; the *Sensitive* or Vital *Soul*, which is common also to Brutes; and the *Spirit*, by which is denoted the reasonable Soul originally created by God, infused into the Body, and from thence after death to return to God; and this his exposition he confirms by agreeing Testimonies of many Ethnic *Philosophers*, and some antient *Fathers*. Much more I should here have

have said in defence of this opinion, had I not thought it less labour to direct the unsatisfied, to a little Treatise intitled a *Natural History of the Passions*, publish'd about three Years past, where the Author professedly handles it. Now if either of these two recited opinions be granted to be true (and 'tis no easy task to refute either of them) then both my positions, that occasioned my recital of them, may be also true; and so the supposed inconsistency of them solved. Presuming then, that what I have said concerning the *First Act* of the Blood, or the Generation of Original Life in the Blood, and the manner how it is performed, is probable, and sufficient to explicate the Theorem; I here conclude my discourse of it. ¶

The *SECOND* Act of the Blood in the race of Life is, the *Excitation of the Motion or Pulsation of the Heart and Arteries*, which seems to be done in this manner. The Blood descended partly out of the Trunc of the *Vena Cava*, partly from the *Arteria Venosa*, into the *Ears* or Portals of the Heart; and there beginning its expansive motion, fills them even to distention; and by that distention irritates or incites their Fibres, which are numerose and strong, to contract themselves, by the motion of *Restitution*. By this constriction of the Fibres on all sides, the cavities of the *Ears* of the Heart are necessarily closed or streightned; and by consequence, the Blood newly admitted into them is squeez'd out into the two *Ventricles* of the Heart, forcing the *Valves* called *Tricuspides*, or *Trisulcæ*, which are seated at the Gates or Mouths of the Ventricles, and open from without inward, to open themselves and give way. The Blood thus propuls'd into the Ventricles of the Heart, and somewhat increasing or intending its expansive Motion, fills them even

to

to distention, and to the shutting of the Valves, which it so lately open'd, so that at that time no more Blood can be admitted, nor what is admitted, recoyl or return by the Wicket through which it enter'd. The Ventricles of the Heart being thus filled and distended, and by virtue of their Fibres spontaneously contracting themselves into a much narrower compass, strongly compress the Blood contained in them, and force it to thrust back three other Valves call'd *Sigmoides*, which open outwards, and to rush forth, partly into the *Vena Arteriosa* leading it into the Lungs from the right Ventricle, partly into the *Aorta* or great artery from the left. By this constriction of the two Ventricles of the Heart, which is their proper and natural Motion, the *Circulation* (as they call it) of the Blood is chiefly effected: that Blood which is out of the right Ventricle express't through the *Vena Arteriosa* into the Lungs, being impell'd forward till it arrive in the *Arteria Venosa* that brings it into the left Ventricle; and that which is expell'd from the left Ventricle into the great Artery, being by the Branches thereof distributed into all the parts of the Body. The Blood being in this manner squirted out, and the irritation ceasing; the *Ventricles* instantly restore themselves to their middle position, and make way for the reception of more Blood from the *Ears* of the Heart, as before; and then being by the Influx and expansive Motion thereof, again distended and irritated, repeat their *Constriction*, and thereby eject it: and this reciprocation or alternate dilatation and constriction, or *Diastole* and *Systole* of the two Ventricles of the Heart, together with the Arteries continued to them, is what we call their *Pulsation*, and the grand cause of the perpetual *Circuition* of the Blood: as the alternate *expansion* and *repression* of the Spirits, during that pulsation, is that motion which

which *Dr. Gliſſon* firſt named, the *Mication* of the Blood, comprehending the double motion in that ſingle appellation.

The Blood then it is, that alone excites the Pulſation of the Heart and Arteries by diſtending them; not by reaſon of any actual *Ebullition*, or any conſiderable *Rarifaction*, it undergoes in either of the Ventricles, or in their avenues; but (as I humbly conceive) merely by its *quantity* ruſhing in.

Not by *Ebullition* or *Effervescence*, as *Ariſtotle*, who gave it the Name of ὄγκωσις, believ'd; (1) Becauſe no ebullition of any Liquor whatſoever, proceeding either from external Heat, or from inteſtine Fermentation, is conſtantly *equal* or *uniform*; whereas the Pulſe of the Heart and Arteries, and conſequently the motion of the Blood that cauſeth it, is in Men healthy, temperate, and undiſturbed by Paſſion, conſtantly equal or of the ſame tenor and rhythm. (2) Becauſe the greater the Ebullition of the Blood, the greater would be the pulſation of the Heart: but in burning Fevers, though there be a very great effervescence of the Blood, ariſing from an extraordinary effort of the vital Spirits contending againſt oppreſſion by the putrefactive or febrile Ferment; yet the Pulſe moſt frequently is low and weak, as *Galen* himſelf obſerved. (3) Becauſe, in living diſſections, if either of the Ventricles of the Heart, or the great Artery be pierced with a lancet; pure and florid Blood indeed will ſpring from the Wound, in every *Syſtole*; but not *frothy*, not *boyling*, nor meteorized; nay, not to be, by any ſign of difference, diſtinguiſhed from Blood at the ſame time emitted from the *Vena Cava* of the ſame Animal. An Argument certainly of itſelf ſufficient to ſubvert the Ebullition of the Blood in the Ventricles of the Heart, excogitated by *Ariſtotle* (at leaſt if he were Author

of

of the Book *de Respiratione* vulgarly ascribed to him) to solve the Phænomenon of the Pulse, and to this day obstinately defended by many learned men, seduced by the Authority of his great name. (4) If the Blood suffer'd any such Ebullition, an immersion or plunging of the Body into cold Water, would depress and calm it, and consequently repress the motion of the Heart: but the experience of divers attesteth the contrary. For these reasons, therefore, among many others here, for brevities sake, omitted, I reject the supposed *Ebullition* of the Blood passing through the Ventricles of the Heart.

I reject also the suddain and impetuose *Rarifaction* attributed to it by the greatest of *Aristotle*'s Rivals, *Monsieure des Cartes*, and strenuously propugned by *Regius* and others his Disciples. For (1) If you open the *Thorax* of any more perfect Animal alive, and while the Heart yet continues to beat strongly, thrust an incision Knife into either of the Ventricles, or into the great Artery; the Blood thence issuing will not appear spumose or rarified at all, but indistinguishable from Blood taken out of the *Vena Cava*, just at its entrance into the right Ear of the Heart. (2) If you cut out the Heart itself, and squeez out all the Blood conteined in it; you shall observe it to vibrate itself a little, and to continue the rhythm of its Pulses, till it be grown cold; and this, not from Blood rarified, for now there remains none within its Ventricles; but most probably from the reliques of the vital Spirits, which yet inhering in the Fibres and little Pullies of the Heart, are the cause that they alternately contract and relax themselves. (3) The musculose Flesh of the Heart is of a contexture too firm and solid, to be inflated by a little Froth; and a greater force is requir'd so nimbly to agitate so massive and ponderose a Machine.

chine. (4) If the Blood were so impensly rarified in both the Ventricles of the Heart, doubtless the Orifices both of the *Vena Arteriosa*, and of the *Aorta*, ought to be much larger; because the rarified Blood would require more of space to its egress, than to its ingress. (5) There would arise a confusion of the motion of the Heart and its Valves; for the diastole of these would be coincident with the diastole of that, which would annihilate the use of the Valves: both which are repugnant to experience, and to the institute of Nature. (6) No reason, why the Blood should be pufft up by great rarifaction in the Heart, only that it may sink and be condensed again, so soon as it is thence emitted into the Arteries: for, what use can there be of the supposed rarifaction, which the very next moment ceaseth? These then are the reasons that hinder me from believing, that a drop or two of Blood can be, by the heat of the Heart, so extremely rarified, as to repleniſh and distend the Ventricles thereof, when the Cavity of the least of the Ventricles, in a Man of middle Age and Stature, will easily contein, according to *Dr. Harvey*'s accompt, two Ounces; much more, according to *Dr, Lower*'s (*lib. de corde cap.* 3. and when I am fully convinced, that in the State of Health and Quiet, the whole mass of Blood is transmitted through the Heart at least thirteen times in the space of an Hour, supposing no more than 2000 Pulses in that time: which would be impossible, if only a few Drops were received into each Ventricle, in every *Diastole*, and expel'd again by the following *Systole*. For, evident it is even to Sense, that in the *Diastole*, both Ventricles of the Heart are filled with Blood even to distention; so that if you feel them at that time with your Hand, they will be found tense and hard: and that by the *Systole*, all the Blood re-

ceiv'd is expreſſ'd; the Sides being then ſtrongly drawn together, and the Cone pull'd up toward the Baſis, ſo that little or no room can be left within to contein Blood. If you open an Eel or Viper alive, you may obſerve the Heart to become *white* in the *Syſtole*, becauſe all the Blood conteined in it, is then ſqueez'd out: and *red* again in the *Diaſtole*, from new Blood admitted and filling it. Nor are we to doubt, but the ſame happens in the Hearts of greater Animals alſo, though the Parenchyma or muſcular Fleſh of the Heart be in them ſo thick, as to hinder the Eye from diſcerning the like alternate change of Colours, in their conſtriction and dilatation.

Taking then the total Repletion of the ventricles in every *Diaſtole*, and the total Exinanition of them, by every *Syſtole*, for granted; and Suppoſing, that in a Man of a middle ſize, each of the Ventricles of the Heart conteins about two ounces of Blood, when it is fill'd; and that the Pulſes of the Heart made in the ſpace of an Hour, exceed not the number of 2000 (which yet is the loweſt computation I have hitherto met with among Anatomiſts) it will neceſſarily follow, that no leſs than 4000 Ounces of Blood are tranſmitted through the Heart in the ſpace of an Hour, which amount to 332 Pints at 12 Ounces to the Pint; whereas the quantity of Blood contein'd in the Body of a Man of a Sanguine complexion, tall Stature, and plentiful Diet, is not allowed by accurate Anatomiſts to exceed 25 Pints at moſt. Let us therefore grant our Man to have that proportion of 25 Pints, to be tranſmitted through his Heart by 2 Ounces at every pulſation: and the conſequence will be, that the whole Maſs of his Blood muſt paſs and repaſs through his Heart thirteen times in the ſpace of an Hour, or elſe the pulſation of his Heart, and his Life too muſt ceaſe,

for

for want of Blood to continue the Motion. But ſince few Men have either ſo much Blood, or (in the ſtate of Health) ſo few Pulſes, as we have now ſuppoſed; 'tis highly conſentaneous, that in moſt Men all their Blood runs through the Heart oftner than thirteen times in every Hour. Now to come to the ſcope or uſe of this Computation; if only a few drops of Blood rarified be tranſmitted through the Heart of a Man at every Pulſe, 2000 pulſes could not tranſmit ſo much as a fourth part of 25 Pints in an Hour; and in the mean time all the reſt of it muſt ſtagnate, and grow cold; and then what would become of his Life, which depends upon the actual Heat and perpetual Circuition of the Blood? This argument certainly is, if not apodictical, yet morally convincing, that *Monſieur des Cartes* his opinion of the impenſe *Rarifaction* of the Blood, in the Ventricles of the Heart, is manifeſtly erroneous.

There remain's then nothing to which the *Diaſtole* of the Ventricles of the Heart can be reaſonably attributed, but the *Quantity* of Blood flowing into and diſtending them. For, the ſubſtance of the Heart being, as well without as within, Muſculoſe, Robuſt, Thick, and intertext with Fibres of all orders or poſitions; and furniſh't alſo with fleſhy Columnes, which being commodiouſly placed in the Ventricles, help much to the conſtriction of them: ſo ſoon as the Blood flowing in, hath diſtended them, they being thereby irritated, inſtantly begin to contract themſelves, by that contraction girding in the Ventricles, and ſqueezing out the Blood. After the ſame manner, that the Stomach, Gutts, Bladder, Womb, *&c.* membranoſe and fibroſe Cavities of the Body, when they are above meaſure fill'd and diſtended, do, by ſpontaneouſly conſtringing themſelves, forcibly expell whatever irritates them.

And that in every *Diastole* of the Heart, Blood rushes into the Ventricles in a quantity *sufficient* to distend them; seems inferrible even from this, that it is abundantly brought in, both by the *Vena Cava*, and by the *Arteria Venosa*; and that it is continually driven on thitherward, partly from the habit of the Body, by the tonic motion of the parts, partly from the Lungs by help of their motion, according to the fundamental Laws of its *Circuition*. But why do I insist upon Reasons, when an easie *Experiment* offers itself to determine the Question? In a Dog opened alive, if the two Vessels that bring Blood into the Heart, namely the *Vena Cava* and *Arteria Venosa*, be girt with Ligatures, so that the course of the Blood be there intercepted; the Ventricles by three or four *Systoles* emptying themselves, their orderly pulsation will cease, only a little undulating Motion, and irregular vibration will thereupon immediately succeed: and upon solution of the Ligatures, and influx of Blood, the Heart will instantly repete its pulsation. I conclude therefore, that the Blood causeth the Dilatation of the Heart, not by its Ebullition, nor by its Rarifaction, but only by its replenishing and distending the Ventricles thereof: and that the Heart, by its spontaneous constriction expresses the Blood into the Lungs and great Artery; and so the motion of both is perpetuated.

I admit nevertheless a certain gentle and pacate expansive Motion of the Blood to be excited in the Ears and Ventricles of the Heart, as necessary to the generation of Original Life, though not of force sufficient to move the whole Machine of the Heart. For the *vital Spirits* in the Blood, though brisk and vigorose in their endevor to expansion, chiefly when they are agitated by the motion of the Heart, are notwithstanding somewhat checkt and repulsed by the reluctancy of

of the groſſer Particles of the Blood; and therefore it cannot be imagined, they ſhould ſuffice to dilate the Heart alſo.

I admit alſo a conſtant invigoration of all the Fibres and fleſhy Columns or Pullies of the Heart, by a continual *Influx from the Brain*; that they may the more expeditely and ſtrongly, and without laſſitude, perpetuate the *Syſtole* of the Heart. For, that ſuch an Influx is neceſſary every Moment to recruit their Vigor, and conſerve the due firmneſs of their tone, is evident from this ſingular *Experiment*. If the Nerves of the *eight pare* be conſtringed cloſely by ligatures, in the neck of a Dog; ye will admire what a ſuddain and ſtrange mutation will thereupon enſue. The Heart, which before performed its motions moderately and regularly, will inſtantly begin to tremble and palpitate, and the poor Animal will labour of anxiety and extreme difficulty of breathing, while the ligatures continue on the Nerves above: but upon removing them, all thoſe diſmal Accidents (which are perhaps to be aſcribed to the ſurcharge of the Heart and Lungs by Blood not ſo faſt diſcharged, as it is imported; and that by reaſon the Syſtoles are rendred weak and languid, the influx from the Brain, that ſhould invigorate the contracting Fibres and Pullies, being intercepted) all the Accidents, I ſay, will ſoon ceaſe, and the Heart renew its pulſation, as before. To this Anatomic Experiment I might have added Arguments of the ſame importance, drawn from the *Palſie* and *Convulſions* to which the Heart itſelf is liable, had not the induſtrious *Dr. Lower*, Author of the alleged experiment, prevented me, *lib. de motu cordis cap.* 2. and were I not conſcious, that I have ſtaid too long upon the cauſe and manner of the Excitation of the Pulſation of the Heart and Arteries, or

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ſecond Act of the Blood in the race of Life. ¶.

Proceed we therefore to the *THIRD*, *viz.* the *Diſtribution* of the Blood into all parts of the Body; which is an act wholly *Mechanic*, and to be attributed to the *Syſtole* of the Heart and Arteries thereto continued. To the *Conſtriction* of the *Heart*, becauſe the Blood contained in the right Ventricle, is thereby of neceſſity expreſſ'd into the *Vena Arterioſa*, and ſo into the Lungs; and that in the left, is thence expell'd into the great *Arterie*, and driven on through the Branches thereof into all the parts of the Body. Nor can it ſeem ſtrange, that this Conſtriction of the Heart ſhould be effected with force ſufficient to impell the Blood in a continued ſtream through the Pipes of the Arteries, till it arrive at the extremities of them, yea till it enter into the very ſubſtance of the parts in which they are terminated. For if we attently conſider (1) the ſtructure of the heart, that it is a Muſcle of a ſubſtance Solid, thick, and firmly compacted; every where intertext with various Fibres, and corroborated within with fleſhy Columns and fibroſe Pullies; and of a Figure fit to perform vigoroſe Motions: (2) that if you put your Hand upon the Heart of any large Animal open'd alive, you ſhall find it hard and tenſe, not eaſily yielding to the Gripe: and if you thruſt a Finger into either of the Ventricles, you ſhall feel it to be with great violence girt and pincht by the *Syſtole* thereof: (3) that if you pierce the great Arterie neer the Original of it, with a Lancet, the Blood will be in every contraction, ſquirted thence with incredible impetuoſity, and to great diſtance: (4) that in ſome Men the Heart invaded by Convulſions, hath vibrated itſelf with ſuch ſtupendous Force, that the very Ribbs have been thereby broken; as the obſervations recorded by *Fernelius*,

*Fernelius*, *Hollerius*, *Foreſtus*, and *Carolus Piſo* atteſt: (5) that in Horſes and Doggs, after they have run, the beating of their Hearts may be plainly and diſtinctly heard to a conſiderable diſtance: If (I ſay) we conſider theſe things, we ſhall ſoon be induced to believe, that the *Syſtole* of the Heart is more than ſufficient to impell the Blood to the extreme arteries. And as for the ſpontaneous *Conſtriction* of *the Arteries*; that alſo muſt needs contribute ſomewhat to the *Pulſion* of the Blood, by leſſ'ning the Pipes through which it flows. Remarkable it is, that the *Contraction* of the Arteries is not Synchronical or coincident with the contraction of the Heart. For, the Syſtole of the Heart is perform'd in the time of its contractive Motion; and the Diaſtole, in the time of the remiſſion thereof: but on the contrary, the Diaſtole of the Arteries is perform'd when they endevor to contract themſelves; and their Syſtole, when they remit that endevor. The reaſon is, becauſe the excluſion of a ſufficient quantity of Blood out of the Ventricles of the Heart being perform'd, the firſt cauſe that impugned the contraction of the Arteries, *viz.* their diſtention by that Blood ruſhing into them, inſtantly ceaſes, and the three *Semilunar Valves* are ſhut, to prevent the regreſs of it; and at the ſame time, the reſt of the Blood in the Arteries remits its expanſive Motion, which was the other cauſe that hinder'd the Arteries from contracting themſelves, and thoſe two impediments removed for that time, the Fibres of the Arteries now prevail, and by contracting themſelves, return to their middle poſture of quiet; by that contraction preſſing the Blood forward on its Journey, till it be impell'd into the ſubſtance of the Parts.

From, whence after it hath done its Office, it is ſoon forced to *return* toward the Heart, through the Veins;

Veins; partly by more Blood flowing after and preſſing it behind; partly by the renitency and tonic Motion of the parts; partly by the tenſion of the Muſcles in the habit of the Body; and in fine, by the Pulſation of the *Vena Cava*, which though but light, is yet perceptible at its approach to the Heart, where (to that end) it is furniſht with fleſhy Fibres; ſo that from thence *Walæus* (*in Epiſt. de motu Sanguinis*) concluded, that the circular Motion of the Blood beginn's from that part of the *Vena Cava*. If I do not here particularly explain the reaſon and manner how each of theſe various Cauſes conduceth to the effect aſcribed to their Syndrome or concurſe; it is becauſe I preſume, that the whole Hiſtory of the Circuition of the Blood, with all its helps and circumſtances, is well known to the greateſt part of my Auditors; and becauſe I haſt to the

*FOURTH* Act in the race of Life, which beginns where the diſtribution of the Blood through the Arteries end's: and is the Communication of Life from the Blood diſtributed, to all parts of the Body. For theſe receiving the Blood impregnate with Original Life, are thereby in a moment heated anew, invigorated, incited to expand themſelves, and made participant of Life Influent; *i. e.* they are ſtirred up to the actual exerciſe of Augmentation or nutrition, and of all other their Faculties. And this Participation of Life is that vital Influx, with ſo great Encomiums celebrated by Anatomiſts; and the Heat of the Body, both actual and vital; and the general cauſe (at leaſt *Sine qua non*) of all the noble Actions of the whole Body. I ſay, the *General Cauſe*; becauſe it is this influent Vital Heat, that revives and ſtirrs them up to activity, when without it all parts would be dull, flaggy and torpid: and yet notwithſtanding it is not ſufficiently able of itſelf to

produce

produce those Effects, unless so farr forth as it is at the same time contemperated and determinated to this or that particular effect, by that which some call the *peculiar temperament*, and others the *Spiritus insitus*, of that Member or Part, whose proper Office it is to cause that effect. For, this vital Heat, or general enlivening and invigorating influence operates one thing in the Liver, another in the Spleen, another in the Stomach and Gutts, another in the Kidneys, *& Sic de cæteris*: assisting and promoting the faculties of all parts, so that no one can execute its proper function without it: as, the irradiation of the Sun is requisite to make the Ground fruitful, and to excite the Seeds of all Vegetables lying in it; and indeed this vital Heat is to Animals, the *Sun* within them, their *Vesta*, perpetual Fire, *familiar Lar*, *Calidum innatum*, *Platonic Spark* pepetually glowing: not that (like our common Fire) it shines, burns and destroys; but that by a circular and incessant Motion, from an internal Principle, it conserves, nourishes and augments, first itself, and then the whole Body. *Unde* (Entius *noster* (in Antidiatribæ pag. 6.) *in hunc finem extructum est* cor, *quod calentis sanguinis rivulis totum corpus perpetim circumluit. Cumq;* Plantæ *omnes, à* Solis *benigna irradiatione vigorem, vitamq; adeo suam præcipùe mutuentur: animalibus cæteris* cordis *calor innascitur; unde, tanquam à* Microcosmi *sole, partes omnes jugiter refocillantur. Ac propterea minùs placet, quòd plantarum germen* Corculi *nomine indigitaveris.* Good reason then had our *most Sagacious Harvey*, to sing so many Hymns, as it were, to this *Sol Microcosmi*, that continually warms, comforts, and revives us. Discoursing of the Primogeniture of the Blood in an Embryon (*Lib. de Generat. Animal. exercit.* 50.) he falls into this elegant encomium of it. *Ex observatis constat, Sanguinem esse par-*

"tem genitalem, fontem vitæ, primùm vivens & ultimò "moriens, ſedemq; animæ primariam; in quo (tanquam in "fonte) calor primò, & præcipùe abundat, vigetq; & à "quo reliquæ omnes totius corporis partes calore influente "foventur, & vitam obtinent. Quippe calor Sanguinem "comitatus, totum corpus irrigat, fovet, & conſervat. "——Ideoq; concentrato, fixoq; leviter ſanguine (Hip- "pocrates, ἀπόλιψιν τῶν φλεβῶν, nominavit) veluti in li- "pothymia, timore, frigore externo, & febrium inſultu "contingit; videas illicò totum corpus frigeſcere, torpere, "& pallore livoreq; perfuſum langueſcere: evocato autem "rurſum ſanguine, hui! quam ſubitò omnia calent denùo, "florent, vigent, ſplendentq;? —— Nec jecur munus "ſuum publicum exſequitur, ſine influentia ſanguinis & ca- "loris per arteriam Cæliacam. Imò vero Cor ipſum, per Ar- "terias Coronarias, influentem unà cum ſanguine calidi- "tatem vitamq; accipit. Quippe nullibi eſt caloris aſſlu- "entia, citra ſanguinis influxum per arterias.——Sanguis "deniq; totum corpus adeo circumfluit, & penetrat, omni- "buſq; ejus partibus calorem & vitam jugiter impertit; "ut Anima primò & principaliter in ipſo reſidens, illius "gratiâ, tota in toto, & tota in qualibet parte (ut vul- "gò dicitur) ineſſe, meritò cenſeatur. In another place (*Exercit.* 51.) vindicating the Supremacy of it over all parts of the Body, he breaks forth into this memorable expoſtulation: "Si Neoterici quidam verè dicant, ani- "malium ſemen coitu emiſſum, eſſe animatum; quidni pa- "ri ratione affirmemus, animam eſſe in ſanguine; cùmq; "hic primò generetur, nutriatur, & moveatur; ex eodem "quoq; animam primùm excitari, & igneſcere? Certè "ſanguis eſt, in quo vegetativæ, & ſenſitivæ operationes "primò elucent; cui calor, primarium & immediatum a- "nimæ inſtrumentum, innaſcitur; qui corporis animæq; "commune vinculum eſt; & quo vehiculo, anima omni- "bus totius corporis partibus influit. In a third place,

(*Exercit.*

(*Exercit.* 70.) where he, with cogent reasons, refutes the vulgar error *de calido innato*, he puts an end to all false notions, and all disputes concerning that Subject, and then concludes in these words: "*Solus sanguis est "calidum innatum, seu primò natus calor animalis.* —— "*Habet profectò in se animam primò ac principaliter, non "vegetativam modò, sed sensitivam etiam & motivam: "permeat quoquoversum, & ubiq; præsens est; eodemq; "ablato, anima quoq; ipsa statim tollitur: adeo ut sanguis "ab anima nihil discrepare videatur; vel saltem substan-"tia, cujus actus sit anima, æstimari debeat.* These remarkable texts I have recited, not to prolong my discourse, but to confirm whatsoever I have said of the generation of Life original in the Blood, and of the communication of influent Life, from the same Blood to all parts of the Body; that so I might with more assurance leave this fourth Act of the Blood fully explain'd, and pass to the ¶:

*FIFTH* and last. Which consisteth in the diffusion of the *exhalations* of the Blood, raised by the expansive Motion or actual Heat of it; and which reduceth it from the State of Arterious Blood, to that of Venose. For the Blood newly impregnate with Life, and kept a while in restraint by the thick Walls of the Heart, and firm Coats of the Arteries, no sooner arrives at the habit of the parts, but instantly it begins to disperse its more volatile Particles in Steams or Exhalations: and those being diffused, it becomes calm and sedate, and is in that composed condition transferred into the capilray Veins, to be at length brought again to the Heart. Of these Exhalations, the more subtil and fugitive part exspires into the Aire by insensible transpiration; the rest striking against membranose and impervious Parts, or perhaps against the very Parenchyma of them, is stop-

ped and repercuſs'd, and condenſed into a Dew. Which after it hath moiſtned the parts, is by their tonic motion ſqueez'd into the *Lympheducts*, and by them carried off toward the Centre of the Body. In the mean time, the Blood after this manner calmed and recompoſed, returns quietly and ſlowly toward the Heart, therein to be quickned, heated and impregnated anew by the expanſive Motion of its Spirits: being driven on all the way by more Blood continually following and preſſing it, and by other concurrent Cauſes, by me a little before particularly mentioned. And this I believe to be the manner and reaſon of the perpetual *Circuition* of the Blood during Life.

Now reflecting upon the five Acts of the Blood deſcribed in the circular Race of Life; the *Sum* of all my perplex and tedious diſquiſition concerning it, amounts to no more but this. That the *Mication* of the Blood proceeds originally from the expanſive motion of the Spirits of it, ſomewhat reſtrain'd and repulſed by the groſs and leſs active parts, and incited by that oppoſition: that from this Mication, *Life Original* is as it were kindled in the Blood paſſing through the Heart: that Life *influent* is communicated to all parts of the Body, from the Blood tranſmitted to them through the Arteries; and from the union of the vital Spirits contain'd in the Blood, ſo brought into them, with the *Spiritus inſitus* of every part that receives it: that to that noble end, Nature hath ordained, that the Blood ſhould be ſpeedily *diſtributed* to all parts through the Arteries, by the Heart ſpontaneouſly contracting itſelf: and ſo ſoon as it hath done that its grand Office of reviving them, and diffuſed its *exhalations*, be brought back again to the Heart, therein to conceive vital Heat anew: and in fine, that the Life of all Animals depends immediately or primarily upon the regular Mication, and

next

next upon this perpetual Flux and reflux of the Blood, by the glorious Inventor of it, *Dr. Harvey*, rightly called (not the Circulation, but) *CIRCUITION* of the Blood,

*Quòd ejus ſemper redeat labor actus in orbem.*

How *probable* theſe things are, Ye, who are Philoſophers and Anatomiſts, have indeed a right to Judge: but ye muſt pardon me, if I adventure to ſay, that ye have no right to Judge, whether they be *true*, or not. For, what *Seneca* (*Natural. Quæſt. lib. 7. cap. 29.*) with great Wiſdom and Modeſty, ſpake of his own reaſonings about the nature and cauſes of *Comets*, may be with equal reaſon applied alſo to mine concerning *Life* (which in more then one thing reſembles a Comet) *viz. Quæ an vera ſint, Dii ſciunt, quibus eſt ſcientia veri. Nobis rimari illa, & conjecturâ ire in occulta tantum licet, nec cum fiducia inveniendi, nec ſine ſpe. Huc item referri poteſt, quod Athenienſis hoſpes reſpondebat Clinio apud Platonem:* τὸ μὲν ἀληθὲς ἀνχυρίζεσθαι, ταῦτα ὅτως ἔχειν, πολλῶν ἀμφισβητούντων, θεοῦ: *Vera hæc eſſe approbare, cùm multi de iis ambigant, ſolius Dei eſt.* If you grant them to be conſentaneous to right reaſon and obſervations Anatomic; I may then not impertinently conclude this Diſquiſition with the ſame Sentence with which my Maſter *Gaſſendus* is ſaid to have concluded his Life;

*Quantula res eſt vita hominis?* ¶:

EPILOGUE.

# EPILOGUE.

AUGUSTUS (*ye know*) *notwithstanding he had long enjoyed whatever the greatest part of mankind calls Happiness, could not yet, when dying, afford to call Human Life by any better Name than that of a* Comedy *or* Farce: *asking his Friends that stood by him,* Ecquid iis videretur mimum vitæ commodè transegisse? *And that this Farce consisteth of five natural Acts too, I have endevored in my precedent Discourse to evince.*

*Why then may not ye expect, that I should, in keeping of* Decorum, *so far persue this double Analogie, as to my short History of Life, to subjoyn an* Epilogue? *Supposing therefore that ye do, I hold myself obliged to add one; such as seems to me to be neither indecent, nor impertinent. It shall be a short History or Tale (call it whether ye please) Written by* Philostratus in lib. 4. cap. 16. de vita Apollonii Tyanei: *Which, I, through hast forgot to touch upon in its due place, and in which there occurrs more than one thing worthy to be remarked. Be pleased then to hear, first the Story itself, in the Authors own Words; and then my brief reflections upon the things therein chiefly considerable. The Story is this.*——

The things I thence collect, are these.

1. *That the Maid was not really Dead, but only* seemed *to be so: and consequently that the raising of her by* Apollonius *was no* Miracle. *For the Author himself, though in the first Line so bold as to call it,* θαῦμα, *a Miracle;*

*is*

*is yet so modest in the second, as to render it doubtful, by these Words;* Κόρη τεθνάναι ἐδόκει, Virgo mori visa est, *the Maid seemed to be Dead*, i. e. *She was not really Dead: and after in his Philosophical descant upon the act of her resuscitation, in these*; Utrum verò scintillam animæ in ipsa [Apollonius] invenerit, quæ ministros, medicosq; latuerat; an decidens forte pulvia dispersam, & penè jam extinctam animam calefaciens, in unum congregaverit, difficile conjectatu est. *Which is a plain confession, that probably she was only in a Swoun; because the Rain that fell upon her Face might raise her.*

2. *That 'tis probable, the Maid lay intranced from a violent* fit of the Mother. *For, this terrible Accident invaded her,* ἐν ὥρᾳ γάμων, *in the very Hour of her* Marriage: *a time when Virgins commonly are most prone to have their Blood and other Humours violently agitated by various Passions, which many times cause great commotions* Hysteric, *and contractions of the Nerves descending* ad uterum,

3. *That the custom of sprinkling cold Water upon the Face of Women in Swouns, is more antient than* Philostratus. *Otherwise he could not have been so easily inclined to believe, that a few drops of Rain that fell upon the Maids Face, might conduce to her restoration; especially when the reason he brings, why an effect so considerable should proceed from so mean a cause, is weak and trivial; and when a sprinkling with hot Water might have been more efficacious.*

4. *And lastly. That* Philostratus *nevertheless shews himself no small Natural Philosopher in this very Phrase;* εἴ τε σπινθὴρ τῆς ψυχῆς εὗρεν ἐν αὐτῇ, an scintillam animæ in ipsa invenerit: *than which none could have been more proper, more significant, more emphatic; at least if the notion of* Original Life, *inkindled and perpetually glowing*

*glowing in the Blood, which I have laboured here to explain, be consentaneous to Truth. And ye may remember, that* Salomon *uses the very same Word,* σπινθὴρ, *in his description of Life, in the forecited place of* Ecclesiastes. *Which is alone sufficient, as to give credit to the Expression itself, so also to excuse my induction of this Story into the place of an Epilogue. Now this* Animæ Scintilla *is liable to Languors and* Eclipses, *chiefly in Women of more frigid and delicate Constitutions,* i. e. *of* little Heat: *and certainly, in every* Syncope *there is* ψυχάριον, *or (as* Plato *calls it)* ψυχίδιον ἀσθενὲς, animula infirma; *the vestal Fire in the Heart dwindling into a Spark. Whence it is, that, at such times, all parts of the Body, wanting a due influx of warm Blood, during the cessation of the Heart, become pale, wan, liveless, and torpid, imitating the Cold of Death. But when the same* Vital Spark *begins to glow again, and renew the* Mication *of the Blood; it soon restores to the whole Body that* vividam ἔκλαμψιν, *or brisk* Effulgency, *whereof it was deprived, during the Eclipse. And this probably was the case of our* Virgin. *No wonder then, if* Apollonius, *either perceiving by her feeble Pulses, the Mication of her Blood not utterly extinguished; or coming luckily in the very Article of Time, when the same began to be more discernible to the touch, than it had been awhile before to the Physicians that were retired; made his advantage thereof, pretending to restore her to life by Miracle: He being an Impostor of singular cunning, and watching all occasions to raise his reputation among the credulous Vulgar, by appropriating to himself the causing of Events, which in truth, though perhaps rarely contingent, were yet nevertheless merely* Natural. *For, who can believe, that this* Spark of Life, *when once utterly extinct, can ever be rekindled in whatsoever Animal; unless by a Power that can reverse, change, and surmount the fundamental*

*Laws*

*Laws and Constitutions of Nature? and that any such supernatural Power was at any time given to* Apollonius, Philostratus *himself was not able to prove. Safely then may we conclude, that this Bride was not really, but seemingly Dead, when* Apollonius *came to her. The same I dare say also of those Animals, which* Malpighi, *and some of our English* Virtuosi *have imagined, and written, they had restored to Life after Strangulation, only by blowing Air, sometimes into their Lungs, sometimes into the* Ductus Pecquetianus. *For, that those Animals had been* propemodum suffocata, *or brought by the Experimentors* and confinium usq; mortis; *is easy to believe: but that they were* quite dead, *and then* revived; *extremely difficult to a Philosopher, who knows, that the Laws of Nature permit no* regress to habit from total privation. *I conclude therefore with* Sr. G. Ent's *most judicious reflection upon this so magnified Experiment* "(Antidiatribæ pag. 143.) Mirandum sanè magis, illis [*Authoribus*] cum Atropo, fatalia abscindente stamina, eam interceſſisse necessitudinem, ut ipsum mortis articulum tam accuratè persentiscerent; *&c. For, in Patients oppressed by the* Apoplexy, Epilepsy, Lethargy, Syncope, *or* Hysteric Passion; *chiefly where no Pulse is perceptible, and the outward parts of the Body are grown cold and stiff; tis extremely difficult to distinguish,* utrum scintillula illa vitalis tantum delitescat, an sit in corde penitus extincta. *So that even* Physicians *themselves, and those too of the highest classis for learning, Experience and Judgment, have sometimes mistaken the Living for the Dead. Of which we have an eminent example in that Prince of Anatomists, but most unfortunate Man,* Andreas Vesalius: *who (as* Hubertus Languettus *hath left upon record, in an Epistle to Casper* Pucerus; *and* Melchior Adamus, in vita Vesalii) *dissecting the Breast of a certain Grandee of* Spain, *whom*

*he thought to be dead the Day before, found his Heart yet panting, to his own and the ſpectators aſtoniſhment, to his eternal diſgrace, the danger of his Life, and exile, in which he miſerably periſht upon the Shore of the Iſland* Zant, *in his return from* Paleſtine. *Doth any Man here expect from me other Examples of the like Miſtakes? Let him ſeek them in* Pliny (Nat hiſt. l. 7. C. 52.) Georgius Pictorinus (Sermon. Convival. l. 1.) Alexander Benedictus (Practic. l. 10. c. 10.) Paræus, Foreſtus, Albertus Bottonus, Schenckius, Levinus Lemnius, Fabricius Hildanus, *&c. for now I have not time to recount them.* Prudenter itaq; faciunt Magiſtratus (*ſaith* Hildanus, Obſervat. Chirurgic. centur. 2. obſerv. 95.) (uti ego Genevæ, & in quibuſdam aliis locis obſervavi) qui neminem ſepeliri permittunt, niſi priùs à quodam viro artis Medicæ perito, & ad hoc negotium deſtinato, inſpecto atq; explorato Cadavere.

*For the ſame reaſon, I approve not the vulgar Cuſtome of ſetting great Pewter Diſhes, Turfs of Earth, or other the like cold and ponderoſe things, upon the Breaſt and Belly of Men newly defunct. For by that means, though the putrefaction and conſequent fermentations of Humors congeſted within thoſe Cavities, may perhaps be ſomewhat checkt and retarded, chiefly in Dropſies, and great Apoſtems: yet in other caſes, and where the perſon is not really, but only in appearance Dead; the ſpark of Life, which is only eclipſed, and otherwiſe may ſhine forth again, is liable to be totally extinguiſhed. Nor am I ſingular in this opinion. For I could at this very inſtant of time convert my eye upon one of the moſt Eminent Phyſicians, not only of this Royal Colledge, but of the whole World; who languiſhing of a grievous and long Sickneſs, and well prepared for a decent* Exitus: *did nevertheleſs, in my hearing (for I had the honour of watching with him that night) give order to his Attendants, to omit that kind*

of

*of treatment of his Body, after all signs of Life should cease in him; adding the very same* Reason *I have here given. And this I have good reason to believe he did, not from fear of Death, but only from his deep insight into the* Nature *of* Life; *of which he ceased not to Philosophize, even when he expected to arrive at the* Period *of his own within few Hours after.* ¶:

# PRÆLECTIO V.

# Of Fevers.

IT is the custom of Mathematicians (as ye, most *Candid Auditors*, well know) when from a Series of Propositions premised and verified, they have inferred the conclusion they sought; to add, as overplus, certain useful Theorems or consectaneous Speculations, by the Græcs called πορίσματα, and *Consectaria sive Corollaria* by the Latins; the knowledg of which is many times of equal moment with that of the Verity on which they depend. Give me leave then (I beseech you) so far to imitate this Method of those great Masters in the art of Reasoning rightly, as from my discourse on *Saturday* last in the morning, concerning the *Primordia*, perpetual Source, and circular race of Life; to deduce a few *Pathological Consectaries*, such as may perhaps afford some glimses of Light toward the discovery, and nature, and causes of a certain *Malady*, which is of all others incident to Mans frail Body, the most common, most grievous, and most dangerous. And this Leave I with the greater confidence ask, because I intend not to abuse it, by digressing impertinently from either my present Subject, or my Duty.

For,

For, the Subject of my Speculation designed, is the same with that of my antecedent disquisition, *viz.* the Blood: and to find out the most probable Causes, and reason of curing great Diseases, is the principal scope and end of all our Enquiries, as well Physiological, as Anatomical. Of which none can be ignorant, who hath perused that little, but oraculous Book of *Hippocrates de Prisca Medicina*, where he teacheth; that it is the great Duty of all Physicians, who desire to render themselves worthy of that honourable appellation [ μὴ λόγῳ μοῦνον, ἀλλὰ καὶ ἔργῳ ἰητρὸν νομίζεσθαι ] not by discours alone, but also by their Works and real succoring of the Sick; to be solicitous about investigating the true Nature, Causes and Remedies of Maladies, above all things. Nor is it new, to find in the Writings of Anatomists, Pathological reflexions subjoyned to the description of the part, which is known to be the primary Seat of the preternatural Affections incident thereunto. Secure then, that what I have resolved with my self at this time to speak, cannot in the end be justly esteemed a *Parergon*, or beside the principal purpose I have taken in hand; and conceiving great Hope, both from the frequency, and from the benign Aspect of this learned Assembly, that hitherto my dulness hath not been able wholly to overcome your Patience: I will presume, ye are not unwilling to grant my so equitable Petition.

In my last Exercitation, I endevored to evince, (as ye may be pleased to remember) that the *Vital Heat* or *Motion* of the Blood doth formally consist in a certain expansive luctation of the spirituose Particles thereof, with the less moveable or unactive, repulsed and prevailing alternately; but mild, amicable, benign, and conducing to the exaltation of all the faculties and Uses of the Blood. Now I come to *add*, that

that it is not only possible, but that it often happens, that this Vital Motion, although proceeding only from the Spirits that conserve and rule the Blood, is by causes beside the institute of Nature invading it, *perturbed*, *interrupted*, *perverted*, and sometimes also wholly *extinguished*: the vital Oeconomy being thereby sooner or later utterly subverted. Of this we have instances almost innumerable. Nor is there any one kind of preternatural Causes assignable, by which Nature may not be impeded in her production of this Vital Motion, and more or less perturbed: as we cannot but observe it within our selves to come to pass, sometimes from the immoderate Heat of the Aire surrounding us, as in *Ephemera*; sometimes from Meats and Drinks potentially too Hot, as in Surfets and drunkenness; sometimes from vehement Passions of the Mind, as in anger, Fear, Grief, *&c.* Sometimes from a fermentation of the Blood, as in putrid Fevers; sometimes from venenate *effluvia* of Bodies, as in pestilential and contagious Fevers; sometimes from a simple solution of continuity of the Parts, as in Wounds: so that in fine, to enumerate all the various causes, by the hostility of which this Life-conserving work of the vital Spirits may be hindred and perverted, is a thing extremely difficult, if not plainly impossible. But in all these so various cases, this is worthy to be noted, as a general verity; that the vital Spirits of the Blood are always *preternaturally* affected, and that the disorder from thence emergent, ought to be imputed to a *p. n.* Cause. Every thing then that *pollutes* the Blood, and that putts Nature to an effort or essay to separate and eject it from thence, as alien and hostile; is wont more or less, according to the diversity of its Nature and Malice, to impugn and repress the vital Motion of the Blood. But nothing hath been observed to do it,

either

either more frequently, or more contumaciously, than *impurities* arising from *Crude Humours* congested in the Mass of Blood, which cannot be separated and extirpated without previous Concoction or Digestion. For, these constituting a certain peculiar *Inquinament* or Pollution of the Blood, put on the nature, and acquire to themselves the efficacy of a *Ferment*; not indeed such as the Leven of Bread, or as the Yest of Ale and Beer; but such, that being in our Bodies mixt with the Blood, which perpetually conceives new vital Heat in itself, produceth the like commotions therein, that those domestic Ferments do in their respective Subjects; and may therefore be not unfitly called a *Ferment*, according to the Name given to it by all Modern Physicians.

For, it causeth a manifest Tumult, or intestine War in the Blood, after this manner. The *inquinament* of the Blood, by reason of the crudity and viscidity of its parts, impugnes and hinders the benign expansive Motion of the Spirits, in which I have declared the Generation of the vital Heat of it to consist: and the Spirits, on the contrary, by their natural tendency to expand themselves, oppose that repressive Force, and strive to defend themselves from oppression; producing by their energy, a continuation of the Mication of the Blood, imperfect indeed, and mixt with Fermentation, but the best they are able, till they have gained the Victory, to produce. So that the Fermentation of the Blood in Fevers, seems to proceed, not from the impurities mixt with the Blood alone; but partly from them, and partly from Nature, *i. e.* from the vital Spirits conserving the vitality of the Blood. For, while *these* are impugned, checkt, and hindred, by *those*; the Motion resulting from that conflict, is indeed a certain Mication of the Blood, but tumultuous, violent,

lent, unequal, and interrupted with little Bubles and Froth. I say therefore, that this civil War in the Blood, as it includes a certain Vital, though imperfect and irregular Mication of the Blood; cannot be denied so far forth to be the work of Nature: but as that Mication is supposed to be tumultuose, seditiose, hostil, and unequal; it must be, in that respect, the product of the Fermentation arising from the inquinament or corruption of the Blood.

This *Fermentation* certainly is the very same thing that the Antient Physicians meant by the *Putrefaction* of the Blood in Fevers: calling, for distinction sake, all such Fevers, which they conceived to arise from thence, *Putrid* Fevers. For it is not credible, that Men of so acute Judgment, and so curiose in observing, as their Writings declare them to have been; by the Word *Putredo*, intended to signifie that sordid and noysom Corruption observed in dead and rotting Carcases, which is absolutely inconsistent with the Principles of Life; but only a more mild manner of dissolution of the Blood, and such as doth impugn and hinder, but not wholly suffocate the vital Expansion of it. And of this we are certain, that they used to affix the Epithet, *Putrid*, to whatsoever doth by a swift Motion degenerate into the nature of *Pus* or *Quitter*. Which is generated, either slowly, by degrees, by a gentle and long process, and also without tumult; as when any Humour is, without a Fever, digested and converted into purulent matter: or speedily, and with great Tumult and disorder of the State of the Body; as in putrid Fevers, when the *Materia Febrilis*, or inquinament of the Blood hastens to Concoction, and the Disease runs through all its Times quickly and swiftly. Of these two so different ways of producing Purulent Matter in the Body, the

former, which is alway simple and without a Fever, is called by the Antients, πεπασμὸς, *Maturation* or *Ripening* of the Matter: the *Later*, which is alwaies with a Fever, is called σαπεδία & σαπεδὼν, *Putredo*. Whence that Aphorism of *Hippocrates* (*lib.* 2. *aph.*47.) *Dum pus conficitur, dolores atq; febres incidunt magis, quam jam confecto.* In their Sense therefore, *Putredo*, is the very motion of the matter of a Fever tending to purulency: and this Motion is the very same, that most of the *Neoterics* Name *Fermentation*. For, in Fevers, it is the Fermentation that brings the impurities to digestion or Concoction, and disposes them to separation from the Blood: and therefore the *Putrid* Matter, and the *Fermenting* Matter signify one and the same thing; and by consequence, the *Materia Febrilis*, and *Fermentum Febrile*, are but two different Names of the Cause whence the Fever or fermentation of the Blood comes. Now if this be granted to be consentaneous to Reason and Experience (as to me it seem's to be) We need no longer amuse our selves with inquiring, either wherein the formal reason of a putrid Fever consists, or how those two Enimies, *Life* and a *Fever* can subsist together in the same Subject, the Blood; for what I have said may serve to expound both those riddles.

Confiding therefore in the firmness of this Foundation, I design to erect thereupon a short *Theory* of the nature, causes, differences, and principal Symptoms of *Fevers*; and that according to the *Model* left to us by that most accurate Surveyor of Natures Works, *Dr. Fr. Glisson*, in his last incomparable Book; reputing it well worth my diligence, to paraphrase upon the Text of so great an Author.

And because to Physicians accurately investigating the differences of preternatural causes inducing Fevers, there-

there occur to be considered more than one kind, as of *Crudities*, so likewise of *Ferments*: that I may not leave myself sticking in the shallows of Ambiguties, 'tis requisite that I clearly and distinctly explain, first what I understand by *CRUDE HUMORS* commixt with the Blood. Which I take to be generally the *Material* Causes of putrid Fevers; and then what I mean by the *Fermentum FEBRILE*, which I suppose to be the *Efficient* cause of them, for by this means, the Fogg of Equivocations being discussed, we shall by a clearer light of distinct notions, contemplate the nature of the things sought after.

As to the *FIRST* thereof, *viz.* the *CRUDITY* of Humours; 'tis well known, that Physicians observing two kinds of *Concoction* or Digestion performed by Nature in the Body, *viz.* One of what is *natural* and familiar, of the *Aliment* requisite to the continual reparation of the Body; which they call πέψις: the other, of what is *preternatural* and hurtful, as the material cause of Diseases; which is named, for distinction sake, πεπασμὸς: have accordingly constituted two sorts of *Crudity*, one *Alimenti*, the other, *Inquinamenti*. Of which the *former*, that respects nutrition, is ordinary; arising for the most part from some error committed in the use of the six Nonnaturals, and consisting chiefly in this, that the Spirits of our Food are either not sufficiently excited, or if excited, yet not sufficiently tamed and subdued by the concoctive faculty of the Stomach, to serve to promote the vital mication of the Blood.

The *Later*, *viz.* *Cruditas inquinamenti*, is in the general, any pollution or corruption of the Blood whatsoever, arising from defect of its due preparation and fitness to admit the vital Mication. And this, being the Mother of Fevers, is that intended by *Hippocrates*

*pocratis* in that most remarkable Aphorism; πέπτα διαφορήσαι καὶ κινῆσαι, μὴ ὠμά; *Concocta medicamento purgare ac movere oportet, non cruda.*

This Crudity is subdivided into two sorts; one *Simple*, which consisting only in defect of due preparation of the Blood, may be corrected *per pepasmum* or maturation, necessarily previous to Evacuation either natural, or artificial: the other *Malignant*, which always includes certain seminal Reliques of some precedent form of the matter mixt with the Blood, highly Hostile to the vital Spirits, and incapable of correction or mitigation, and many times of expulsion. Now from this Malignant crudity of matter mixt with the Blood, ariseth a *Malignant* Fever; and from the simple Crudity, comes a *Putrid*. Of both which we shall speak more copiously, when we come to consider the *differences* of Fevers.

As to the *SECOND*, *viz.* the difference of *FERMENTS* incident to our Bodies; I advertise, that they also may be (as to my present disquisition) commodiously referred to two kinds. Of which the *one* may be called *Fermentum irritans*, because it doth primarily, by it self, and directly irritate the vital Spirits of the Blood, to begin an extraordinary commotion, and seditious Tumult, with the grosser parts of it; and to endevor to deliver themselves from confinement, and by dissolving the common Bond of the whole Mass thereof, to fly away. And under this kind are comprehended all fermenting mixtures abounding with saline Spirits, highly volatile, and not easily tameable by the digestive faculty of the Stomack: among which the *Stum* of Wine is eminent.

The *other* deserves to be named *Fermentum Opprimens*; because it at first and immediately oppresses the vital

vital Spirits of the Blood, impugning their expansive Motion; tho afterward, secondarily, and by accident, it irritates them to a *Pneumatic* Fermentation; not to dissolve the whole mixture thereof, and so to make way for themselves to fly away: but only to attenuate, discuss, eject and exterminate the Ferment, that by clogging and oppressing them, hinders their spontaneous expansion, and the vital Mication of the Blood thereon depending. And this to me seems to be that kind of Ferment, by which a Fermentation of the Blood is wont to be excited in putrid Fevers; and which for that very cause, ought to be nominated *Fermentum Febrile*. It seem's also to consist of any crude humor whatsoever commixt with the Mass of Blood. For, this doubtless is that *Crudity*, which *Hippocrates* (in the newly cited Aphorism) forbids to be importunely attempted by purging Medicaments, until Nature hath mitigated, tamed, and prepared it for evacuation, by gradual digestion

Of which Counsel, though many reasons have been, by the learned Commentators on his Aphorisms, chiefly by *Cardan*, alleged; yet the most credible, and therefore the most considerable seems to be this; *That Nature hath provided no Organs for the Separation or Secretion of such Crude Humors from the Blood, the Spirits of which are not yet exhausted.*

Most true indeed, and evident it is, that Nature has with amirable Wisdom and Providence taken care to preserve the Blood pure and undefiled; and to that end framed, and most advantagiously placed three conspicuous *Secretory* Organs, for the purifaction of it, *viz.* the *Liver*, *Kidneys* and *Stomach* with the conjoin'd *Intestines*: and yet it is no less true, that none of these is, by her primary institution destined to separate and drein from the Mass of Blood, any

matter

matter yet remaining in the ſtate of *Crudity*, or not yet deſpoiled of its Spirits; but all three ordained, leſt the Blood, after it hath ſpent and conſumed the ſweet and profitable Spirits of the Aliment, and becomes thereby effete and ungeneroſe, ſhould be longer detained in the Body; and like a dead Body bound to a living, pollute and infect the Blood newly made of Chyle lately imported, and repleniſh'd with ſweet and uſeful Spirits.

Now the Humors here by us ſuppoſed to be both the antecedent and conjunct Cauſes of Fevers, are not ſuch as have already been ſpoiled of their Spirits, and apt to turn vappid; but ſuch as abound with Spirits yet unvolatilized, and infeſt to the vital Mication of the Blood. For, the matter not ſufficiently digeſted, altered, and elaborate in the Stomach, becomes at length apt to produce Fevers, in this reſpect only, that the Spirits contained in it, are either not ſufficiently excited, or not ſufficiently ſubdued and tamed. Likewiſe the matter that grows crude and apt to generate Fevers, either from defect of due eventilation by inſenſible tranſpiration, or from want of free motion, is not vitioſe, becauſe the Spirits of it are already diſſipated, but only becauſe they are, contrary to the inſtitute of Nature detained, and becauſe they at the ſame time impede and ſomewhat ſuppreſs the vital Mication of the Blood. In fine, the *Seminia heterogenea*, unalterable reliques of ſome precedent form remaining in the crude Matter commixt with the Blood, cauſe a *Malignant* Fever; not becauſe the Spirits of that matter have been already exhaled, but becauſe they are hoſtile, highly infenſe and pernicious to the Vital Spirits, and incapable of being tamed. We have reaſon then to believe, that the material cauſes of Fevers are not the dead, uſeleſs and excrementitious parts of

of the Blood: not the *Phlegm*, not the *Bile*, nor that thin Humor consisting of the *Serum*, Salt and Tartar of the Blood, which is separated in the Kidneys: for all these have their peculiar *Secretory* Organs, by which they are daily separated and carried off: nor do they require any other Preparation to their Separation, but what consists in their transmutation into those Humors *in Specie*. Wich is done only by the gradual *deflagration* of the Blood, by which the vital Heat is sustained. For, hence it is, that in tract of Time, the nobler parts of the vital Juice are dissipated and consumed, and the remaining Parts, which they had before kept united, divided into various parties, and becoming excrementitious, pass some into *Bile*, some into *Phlegm*, and more into the matter of *Urine*: and all these now unprofitable Humors, being brought together with the Blood, to the respective Organs in which they ought to be separated, are there by way of percolation secerned, and by their proper excretory Vessels carried off and ejected.

If this be admitted for true, what then are we to think of the long-lived and even to this Day flourishing Doctrine of the *Antients*, that attributes *tertian* Fevers to *Choler*, *Quotidian* to *Phlegm*, and *Quartan* to *Melancholy*?

I answer (with *Dr. Glisson*, who in all arguments endevor'd, as far as his Devotion to Truth would permit him, to sustain the auctority of the Antients) that those Humors were, or at least might be taken, either for the *reliques* of the Stale and vapid Blood, or for Humors *analogous* to them.

The *Reliques* of the Blood are (as was just now said) resolved into *Bile*, *Phlegm*, and *Urine*; in the last of which are contained four other kinds of Excrements, *viz.* the *potulent matter*, *Salt*, *Serum*, and a certain

earthy

earthly liquamen, commonly distinguished by the name of *Tartar*. But as for *Melancholy*, no place is to be found for it among the reliques or stale and rejected parts of the Blood. For in the whole Body we find no peculiar Organ provided by Nature for the Secretion, reception and exclusion of any such Humor: and therefore, saving the respects and veneration due to those Fathers of our Art, the interest of Truth, which is still more sacred and venerable, obliges us to affirm, that they erred most egregiously, when they assigned that Office to the *Spleen*.

The Humors *Analogous* to the newly enumerated Reliques of the Blood, are signified by the same Names; in particular, the viscid, insipid, and white part of the Blood, is called *Pituita* or *Phlegm*; the hot, drie, acrimonious, and pungent or corroding, *Bilis* or Choler; the cold, drie, blackish, and adust, *Melancholy* (if at least any such Humor may be admitted to lye concealed in the Mass of Blood.) For, we must confess, we usurp more than a Physical License, when we call this an Analogous Humor, to which nothing that holds any the least resemblance or analogie, can be any where in the whole Body found: and yet nevertheless it may be lawful to say, that the Analogie that some parts of the Blood seem to have to that fictitious Humor, which the Antients imagined to be separated and received by the Spleen; may serve to excuse us, if, out of compliance with custom and the vulgar Doctrine of the Schools, we retain the denomination, while we rectify the Notion of Melancholy. For, though the *Analogatum* be wanting; yet if in reality a thing respondent thereto, hath existence in Nature; the supposed Analogy is enough to justify the appellation.

Considering this, I assert, that in the Mass of Blood are

are most commonly contained. (1) A sharp, pungent or corrosive *Serum*, such as is wont to be cast out by exsudation, in an *Erysipelas*, and in the little Bladders or Blisters raised by Epispastic emplasters; which answers to the *Bile* or *Choler*. (2) A whitish and fibrose *Grumus*, that resembles *Phlegm*. (3) A duskish or blackish and friable *Grumus*, comparable to the *Melancholy* of the Antients; for other Humor that may deserve that Name, there is none to be discerned in the Blood.

Now, that we may see how far these Elements or constituent Principles of the Blood, can be brought to consist with the Humors of the Antients; let us equitably compare these with those. According to their several Characters or descriptions, the pure and natural *Serum*, by which mixt with the *Lympha*, the Blood is made and kept fluid, seems to be the same with the natural and pure *Biliose* Humor of the Antients; and the same corrupted, and thereby grown acrimonious and corrosive, what they understood by *Choler*, analogous to the *Gall*. (2) The white and viscid *Grumus*, while uncorrupt and in a natural State, seems to agree with their natural *Phlegm*; when degenerate and corrupt, with that morbific Humor, which they called *Pituita Analoga*. (3) The black and friable *Grumus*, when pure and sincere, is the *Humor Sanguineus* specially so called, and that very part of the Blood, which impregnate with vital Spirits and the nitrose Spirit of the Air, gives it a florid red Colour: but despoiled of those Spirits, and receding from that Scarlet toward a sooty or black (whence probably it received the Name of *Melancholy*) is the *Melancholy* they imagined to be like the Humor of the Spleen. This *Paralleliſm* being granted, there seems to remain no difficulty in reconciling the

Doctrine of the Antients concerning the Humors contained in the Blood, with the constituent Parts of it now observed by us: and by consequence, nothing hinders, but these *Analogous Humors*, as we have distinguisht and described them, may be the *Material* causes of putrid Fevers: yea more, tis necessary, that one or more of them be peccant in every putrid Fever. Which is what we sought, toward the establishing our present Genealogy of putrid Fevers, without demolishing what the Antients have delivered of the same. ¶:

Let us then proceed to enquire into the Origine of *Malignant* Fevers, which ought to be deduced from a certain Ferment of another kind, not yet described. For, malignant Fevers being by their Nature alwaies more pernicious, than simply putrid, and often also contagious: it must be therefore, that they take their Original from some Ferment more malicious, and more grievously hostile to the vital Motion of the Blood. This Ferment then, whatsoever we shall at length discover it to be, may justly be named in the general, *FERMENTUM MALIGNUM*; as coming neer to the nature of *Poison* properly so called, about the reason of whose fierce and pernicious Operation upon the very principles of Life, Physicians are strangely divided in their Opinions. Omitting all which, I humbly conceive, that the deleterious or deadly force of any Poison whatsoever, doth consist, not in any manifest quality, but in some *Seminal* Nature highly adverse and destructive to the Mication of the Blood in Man, upon which his Life immediately depends. There are, (I must confess) too many other things, that with equal speed and cruelty break asunder the slender Ligaments of Life, even by

by their manifeſt qualities, if once admitted into the Stomach; as Fire, Oyl of Vitriol, ſtrong Spirit of Salt, *Aqua Fortis*, Lixivial Cauſtics, Arſenic, Sublimate, *&c.* Which by reaſon of the extreme ſubtility and moſt rapid Motions of their Particles, and of their force of Penetrating, cutting, corroding and diſſolving almoſt all Bodies to which they are applied, are as mortal as a Sword or Bullet: but all theſe, if they be ſufficiently *diluted*, loſe their fatal Virtue, and become innoxious; nor can they be rightly reckned among *Venoms*, no more than a Dagger or Halter, becauſe they deſtroy by manifeſt Qualities, and wayes evident to the Senſe. But *Poyſon*, whoſe Power is founded in a *ſeminal Nature*; ſecretly repugnant and pernicious to human Nature, whether it be bred in the Body, or introduced by contagion or otherwiſe, is always more or leſs noxious in a ſmall quantity, and in a full Doſe deadly; ſo that tis dangerous to truſt to a dilution of any ſuch Venom. And to this kind are the *Malignant Ferments*, of which I am now ſpeaking, to be referred: though ſome of them be more venomous than others, and ſome more contagious. For, the *Malignity* of all ſeems to conſiſt in a Seminal Nature, which being communicated to the Blood, is apt to impugn, retard, oppreſs, and (when it prevails) totally extinguiſh the expanſive Motions of the vital Spirits that conſerve it. ¶:

*HAVING* thus conciſely explained the formal reaſons, and diſtinct proprieties of both ſorts of Febrile Ferments, the Putrid and the Malignant, that work immediately and *per ſe*, by way of *Oppreſſion* of the vital Spirits; 'tis opportune for us to inquire into the Nature of them conſidered, firſt *abſolutely*, and then *reſpectively* to the manner of

their Operation upon the Blood in generating Fevers.

I advertiſe therefore, that when I ſpeak of *Crude* Chyle brought into the Maſs of Blood, and by degrees inducing putrefaction or Fermentation upon it, as I have briefly ſhewn in the Paragraph concerning putrid Humors rendring the Blood impure; I do not call ſuch Chyle *Crude*, becauſe I think it wholly unfit to afford ſome nouriſhment to the ſolid Parts, though impure and imperfect; but becauſe it is not ſufficiently concocted and prepared, ſo as that being united with the Blood, it ſhould be made the immediate Subject of the vital Spirits, or (which is the ſame thing) be impregnated with *Vitality*. Now Chyle in this ſenſe *Crude*, hath not yet attained to a degree of inquinament high enough to give it the nature and force of a *Febrile Ferment*; which ſtrikes at the very Root of the vital Motion or Heat. For it conſiſteth in a certain *Aptitude* to infringe, diminiſh, retard, oppreſs, and (if not overcome and expell'd by the Spirits of the Blood) utterly extinguiſh the vital Mication of the Blood, whence Life reſults. For, conſentaneous it is both to experience and to reaſon, that this appitude is not acquired in a few moments of time after Crudities have been commixt with the Blood; nor doth it actually attack the vital Spirits ſo ſoon as the Ferment is diffuſed, but doth exſert its Power ſlowly, by inſenſible degrees, and as it were by creeping on, like an Enemy that deſigns to ſteal a Victory. Firſt it gently, and by little and little inſinuates itſelf into the Maſs of Blood, and diffuſes itſelf equally through all the parts of it. Then it comes to be united with the Spirits that conſerve the Blood, as if it were a natural ingredient of the mixture. That done, if either the quantity or contumacy of it be ſo great,

great as that the vital Spirits be unable to moderate and reduce it to conformity, or to expel and diſſipate it; it begins to operate, to weaken, and ſuppreſs them, affecting them with a kind of *Torpor*, and clogging them ſo as they cannot with requiſite Vigor endevor to expand themſelves, and then the *Fever firſt invades*, as ſhall be more fully explicated when we come to examine the proceſs of Fermentation in the Paroxyſm of an intermittent Fever.

In the mean time it follows to be inquired, wherein this Aptitude of the *Fermentum Febrile* to fix the Spirits of the Blood, doth chiefly conſiſt. I conceive with *Dr. Gliſſon* that it is radicated in a certain *Lentor* or *clammineſs* of the Crudities mixt with the Blood; analogous perhaps to that viſcidity obſerved in Wine and Beer not perfectly fermented, which are therefore call'd *Pendula*, or *Ropy*; nor can they be ever corrected unleſs by a new Fermentation, which exciting the oppreſſed and ſluggiſh Spirits contained in the Liquor, and diſſolving the clammyneſs of the groſſer Parts, quickly clarifies it. For, what can be imagined more apt to Clog, oppreſs and fix the Spirits of the Blood, ſo as to hinder their expanſive Motion, than ſuch a pendulous clammineſs of Crude Humors diffuſed through the whole Maſs of it? I believe therefore, that the formal reaſon of every febrile Ferment in putrid Fevers, doth conſiſt in ſuch a *Lentor* of the Blood. As for that kind of it, that ariſes from defect of Concoction in the Stomach, and that may therefore rightly enough be diſtinguiſhed by the Name of *Crude Chyle*; it ſeems not at firſt to be affected with the pendulous Clammineſs here deſcribed, but only with a certain diſpoſition or tendency toward it, by reaſon the Spirits of the Chyle have not been ſufficiently excited and exalted from the State of Fixation

to

to that of moderate fluxility, as they ought to have been: and yet this tendency may be sufficient by degrees to induce a clammineſs upon the whole Maſs of Blood, when crudities are daily increaſed and accumulated, as commonly they are before a Putrid Fever is generated. Other kinds of it are almoſt all derived, either from tranſpiration intercepted, or from extravaſation of Humors, as in internal Apoſtems and in the Dropſy; or from inflammations and tumors, where the courſe of the Blood is ſtopt. For part of the Blood ſo arreſted, and for want of due Motion corrupted, being at length carried off by the Veins, and remixt with the whole Maſs thereof, muſt of neceſſity more or leſs pollute it,

But if we convert the Eyes of our Curioſity upon the *Effects* of this febrile Ferment, and conſider the manner and proceſs of its acting upon the Blood; we ſhall ſoon find, that what hath been ſaid of the *narcotic* and *fixative* Power of it, will be ſufficiently conſentaneous and evident to engage our Belief. For, from thence it will appear, by what reaſon and way the Ferment is wont to exert its forces, and exerciſe its tyranny upon the Vital Spirits, in the divers times of a *Paroxyſm* or fit of a Fever, *viz.* in the begining or *invaſion*, in the *augment* or increaſe, in the vigor or *Achme*, and in the *declination*.

I ſay then, that before the actual invaſion of a Paroxyſm, the febrile Ferment is already diffuſed through the Blood, and united with the vital Spirits. Upon this, it of neceſſity comes to paſs, that the Spirits being clogg'd and as it were inviſcated by the pendulous clammineſs thereof, remit ſomewhat of their vigor and endevor to expanſion: and conſequently with leſs briskneſs irritate the Ears and Ventricles of the Heart, and Arteries conjoyned to them, to contract

tract themselves, in order to the distribution of the Blood. Hence it comes, that the free transpiration of the *halitus* or steams of the Blood is more or less checkt, and render'd more slow and weak than it ought to be. And this makes the *first* insult or surprise of the *Cold* Fit, which though scarcely perceptible in the beginning, comes creeping on more and more, till the Eclipse it brings upon the vital Spirits, be manifest from the weakness and languid Motion of the Pulse, and from the chilness of the whole Body, and dead paleness of the Face, *&c.*

A little after, the Pulse is more retracted and languid, and the Eclipse increasing, the Nayles of the Fingers become pale and of a leaden Blew, the extreme parts grow sensibly cold, and all the other symptoms grow more strong and vexatious, so that the Patient is now compell'd to feel the Attacque his Enemy is making upon the Guards of his Life. And this is the *second* step of the cold Fit.

Which ceases not yet, but is continued a good while after its first sensible Invasion; the depression of the vital Spirits, the retraction of the Pulse, and the consequent diminution of Heat, still by degrees increasing. Nevertheless, soon after the beginning, the irritation of the vital Spirits to rise up and oppose their intestine Enimy, and to repell it by their spontaneous expansion, begins. For, first they strive to resist oppression by the clamminess of the febrile Ferment, and to shake off the Clogg, by their natural agility. Then the Mass of Blood, being slowly and heavily diffused into the parts of the Body, doth in some degree stagnate in the Avenues of the Heart, and by its resistence burden the Heart and Arteries, and so incite them to make more frequent Pulses, to discharge it. Then the *Effluvia* of the Blood, being by intercepted

cepted tranſpiration retained, and by the Veins returned to the Heart, ſerve ſomewhat to excite the Spirits, and to diſcuſs a little of the clammy Ferment repreſſing them. But yet theſe three irritations conjoyned, are not from the beginning of ſo great Moment, as quickly to hinder the increaſe of the Cold, or farther depreſſion of the vital Motion: only they ſo far avail, as to hinder the influent Life from being wholly eclipſed. And at this time it is, that the firſt certain Signs of actual Fermentation of the Blood, ſhew themſelves to Phyſicians accurately obſerving them. For, ſo ſoon as the certain Signs of an univerſal oppreſſion of the vital Spirits appear; we may from that time date the commencement of the Fermentation immediately conſequent thereunto: becauſe they declare that the Ferment hath already actually begun its Work.

Theſe *Signs* and *Symptoms* then are (as I have ſaid) *firſt*, *retraction* of the Pulſe, *chilneſs*, *paleneſs* and ſometimes *blewneſs* of the extreme Parts, chiefly of the Nayls, tipp of the Noſe and Lips, and ſome light *conſtriction* of the whole Skin. Becauſe at that time there happens ſome oppreſſion of the vital Heat, which governs the Pulſe, renders all parts actually hot, gives a vivid and grateful tincture of red to all, and plumps up the Skin that otherwiſe would ſhrink itſelf up.

*Secondly*, a troubleſom Senſe of *Cold*, accompanied with a *Horror*, *trembling*, *ſhivering* or *ſhaking*. All from the difficult paſſage of the Blood through the habit of the Parts. For the Blood being but weakly emitted from the Heart, and paſſing ſlowly through the ſubſtance of the muſcular Parts, hurts and offends them by vellication or attrition.

*Thirdly*, a weak and quivering *Voice*, and ſhortneſs of

of *Breath* for the moſt part trembling and unequal: which ſeem to ariſe, partly from a depreſſion of the vital Heat, partly from Cold unequally affecting the Lungs, and hindring the free ingreſs and egreſs of the Air; and partly from the difficult paſſage of the Blood, either through the Lungs themſelves, or through the Muſcles, helping to move them.

*Fourthly*, the *moiſture* of the Mouth, and in the Glands circumjacent, begins to be dried up, and thereupon enſue *thirſt* and *drineſs* of the Tongue. The reaſon of which ſeems to be this, that the *Latex Seroſus* is, in the febrile Fermentation, ſo confounded with other Humors, that it cannot be ſeparated from them in the Glandules deſtined to the Secretion of it. Other Effects or Signs of the Fermentation obſervable in this beginning of the Paroxyſm, I reſerve till we come to the *Augment*, in which they become more conſpicuous.

In the *AUGMENT* therefore, no new Motion ariſes, only the former are either by degrees leſſned, or increaſed. Thoſe that belong to the ſimple *depreſſion* of the vital Spirits, are gradually diminiſhed: but thoſe that are referrible to the *incitation* or ſuſcitation of them, are by little and little augmented. Of the *former* ſort are, *Chilneſs*, Senſe of *Cold*, *ſhivering*, *trembling*, *quaking*; all which by degrees ceaſe and vaniſh: becauſe upon the raiſing of the Pulſe, the Blood is tranſmitted more briskly and ſpeedily through the habit of the Parts. The *Voice* alſo becomes more ſtrong and uninterrupt, and the *reſpiration* more frequent and equal, for the ſame reaſon. On the *contrary*, the provoked vital Spirits now riſing up againſt their inteſtine Enimy, cauſe a manifeſt increaſe of the febrile Fermentation and Tumult. For, the expanſive luctation grows more and more fierce and exor-

bitant, and recedes farther from the natural State, till it becomes turbulent, hoſtile, and frothy, and unequal. The *conſequents* of theſe irregular Motions are (1) *inquietude*, *jactigation*, and ſometimes *Pain* of the outward parts, but chiefly of the *Head*; all from the difficult tranſmiſſion of the Blood through them. (2) *Frequency* of the Pulſe, and now and then *robuſt* vibration of the Heart and Arteries; probably from the intercepted courſe of the Blood, and the augmentation of Heat. (3) *Diminution of Tranſpiration*; which though now ſomewhat greater than from the beginning, continues much leſs than it ought to be, conſidering the abundance of *Effluvia* or exhalations of the Blood raiſed by the intenſe Heat. (4) Greater *Conſumption* of the *Latex* in all parts of the Mouth, and conſequently more grievous *Thirſt*. (5) *Nauſeouſneſs*, and ſometimes *vomiting* or *Flux* of the Belly. For the Stomach and Gutts are of all parts moſt troubled and offended by the tumultuoſe afflux of the Blood, as well becauſe of their nervoſe Texture, and their exquiſite Senſe thence ariſing; as by reaſon of the matters contained in their Cavity, which (the containing Parts being irritated) fluctuate, and ſo become more apt to be moved and ejected upward or downward: and for the ſame Cauſes, the ſame parts are often moleſted with *Winds* and *Eructations*; all *Pneumatic* Fermentations (in the number of which our febrile Fermentation hath a place) conducing much to the generation of Winds. During this time of the Paroxyſm, the Fermentation and Heat, and all the conſequents of them here recounted (excepting perhaps the laſt) are augmented by degrees, till they arrive at the *Acme* or *State*. But ſo ſoon as the Tranſpiration comes to be more free, and anſwerable to the abundance of Exhalations ſteaming from the Blood,

ſo

ſo as they no longer recoyl by the Veins to increaſe the eſtuation of the Blood; the Augment ends, and the *State* of the fit ſucceeds.

In which the Fermentation and Ardor perſiſt a while in their Violence and Fury. And though at this time ſome parts of the oppreſſing Ferment, begin to be diſcuſſed and expelled by laborioſe Sweat: yet the vital Spirits are by that tumultuoſe Motion ſo profuſely ſpent and exhauſted, that nature ſuffers almoſt as much of loſs by that exhauſtion, as ſhe receives relief from the Victory and Expulſion. Whence perhaps it comes, that yet the conflict appears doubtful and equal, till the beginning of the Declination, when the febrile Heat, and all its concomitants are by degrees mitigated.

And then it is, that the Victory of the vital Spirits being complete, the remaining parts of the febrile Ferment are by an univerſal Sweat flowing without any conſiderable detriment of the ſtrength of the Patient, diſperſed and exterminated. For, this Sweat is a kind of deſpumation of the impurities of the Blood that cauſed the Paroxyſm; whereupon ſoon enſue a remiſſion of the burning Heat, a ceſſation of anxiety and Pains, and a freſh diffuſion of the *Latex Seroſus* into the Throat and Mouth for the quenching of Thirſt, and in fine a Ceſſation of all other vexatious Symptoms of the late Conflict; and ſo at length the Paroxyſm is ended. Now from this our congruous Solution of all the *Phænomena* of the fit of a Fever, ye may eaſily judge of the reaſonableneſs of the precedent *Hypotheſis*, according to which I have endevored to explicate them; and how far the ſame may deſerve your approbation, or diſlike. ¶:

Nevertheleſs I am willing, ye ſhould ſuſpend your Sentence, till I have carried on the Hypotheſis farther.

For there yet remain many other Appearances to be ſolved. I proceed therefore to the primary *DIFFERENCES* of Fevers, in hope that they alſo may be commodiouſly deduced from the ſame Principles.

Foraſmuch as it is probable from what hath been ſaid of the nature of a Fever in general, that all Fevers ariſe from, and eſſentially conſiſt in a Fermentation of the Blood: We may with reaſon infer, that the diverſity of Fevers, how great ſoever it be, proceeds from nothing elſe but the divers fermentations of the ſame Blood. For the diverſity of Effects is for the moſt part reſpondent to the diverſity of efficients. And ſince it is ſcarce poſſible, but that from various Ferments, various kinds of Fermentations ſhould ariſe; it neceſſarily follows, that the various ſorts of Fevers are to be deduced from equally various Ferments actually hindring the vital mication of the Blood. And I hold, that there are ſo many differences of febrile Ferments, as there are divers Natures or Diſpoſitions of Crudities incident to the Blood, and apt to inquinate it. To know all theſe diſtinctly, and to explicate each of them by a particular diſcription, is perhaps impoſſible: ſo great is the variety of crude Humors that may be admitted into the Blood, and ſo manifold the Combinations of them that may happen to pollute it. Let it ſuffice then, if reflecting upon the chief ſorts of *Crudities* alredy deſcribed, we ſhall from thence congruouſly derive the *Primary*, *i. e.* the moſt frequently obſerved *Differences* of Fevers.

By *Crudity* I here underſtand any inquinament or depravation of the Blood whatſoever, proceeding from defect of due preparation thereof, for the generation of vital Spirits; as I before declared. Now the matter

ter in this Senſe *Crude*, may be diſtinguiſhed into *Ordinary* or familiar to human Nature, ſuch as ariſes from the erroneous uſe of the ſix non-naturals: and *Extraordinary* or alien and hoſtile to human Nature. From the *former* come all Fevers call'd *ſimply Putrid*: from the *Later*, *Malignant* and *Contagioſe* or Venenoſe.

The *Ordinary* may be ſubdivided into (1) *Recent* or lately generated, ſuch as is either carried out of the Stomach and Guts in the form of crude Chyle, or reduced from ſome part or other inflamed or otherwiſe corrupted: and (2) *Inveterate* or in a long tract of time by little and little congeſted, and adhering to the ſubſtance of the ſolid Parts. The *former*, if it happens to paſs into a febrile Ferment, produces a Fever putrid indeed, but of only *one* Paroxyſm. The *Later* likewiſe generates a Fever Putrid, either accompanying ſome other Malady, or Symptomatic; but each of them, either *Continual* of uncertain exacerbation, or *intermittent* of uncertain Paroxyſms.

The *Etraordinary* or Malignant which includes ſome certain ſeminal Principle dangerous and hoſtile to human Nature, is alſo *double*, *viz.* either it is diſſeminated by contagion, or is primarily bred in the Body affected. The *Former*, though reſolved into an exhalation and diſperſed through the Air, ſtill retains its poyſonous Virtue, as the *Miaſma Peſtilentiale*, or infection of the Plague. The *other* is either not reſolved into exhalations, as *Arſenic*; or is, in the very reſolution, deſpoiled of its ſeminal malignity, as the Breath of a *mad Dog*, which ſeldom or never infects alone, without the *Saliva* in forth.

Having exhibited to your conſideration this plain and brief Scheme of the different material Cauſes, from which I ſuppoſe the principal differences of Fevers

vers to proceed; I must reflect upon the Heads thereof more particularly, and in the first place resume the explication of Crudity not Malignant; as that which both more frequently occurs to our observation, and is less obscure.

The *Matter* of *Putrid* Fevers *Not-Malignant*, proceeds (as I lately insinuated) either (1) From defect of Concoction of the Chyle in the Stomach and Intestines, or (2) From defect of due eventilation and free motion of the Blood in its Circuit.

*Defect of Concoction of the Chyle*, is a thing so common, and so fully explained by Physicians in their practical Writings, that it is sufficient for me to name it. And indeed in all Fevers, the concoctive faculty of the Stomach is wont so much to languish, that scarce any thing of aliment can be, without detriment, taken into the Stomach already troubled and inquinated with vitious and corrupt Humors. For then the Food is not digested, but whatever of either Juice or Tincture is drawn from it, remains crude, and turns to the Augment of the matter of the Fever. Whence it comes, that fasting and a thin Diet are so much commended by all, in putrid Fevers. Only in Pestilential, a Diet less spare, is sometimes allowed with good Success: because the benignity and sweet Spirits of the Aliment, are found to contemperate the *Seminium Pestiferum*, and reduce it to a milder disposition. Not of *these* Fevers therefore, but only of *those* are we to understand the Counsel given by *Hippocrates* (*Aphorism. n. Lib.* 2.) *Corpora impura quò plus alimenti assumunt, eò pluribus damnis augentur*: & (*Aphor.* 7. *Lib.* 1.) *si morbus sit peracutus, tenuissima diæta est utendum.*

*Defect of due Transpiration, or Eventilation, and of free Circuition of the Blood*, is sometimes the Cause, sometimes

sometimes the Effect of Fermentation therein. The *Cause*, if no other vice, before disposing the Blood to Putrefaction, hath given fit matter for the Generation of a Fever: for, want of free Transpiration and Interception of the course of the Blood in any part of the Body, is alone sufficient to infer putrefaction upon the Blood; but then the Fever is for the most part easily discussed, and with one universal Sweat wholly solved. It ariseth commonly from the diminished perspirability and permeability, either of the whole Body, or of some private part, whose inconspicuous pores are constipated, or obstructed; and this happens either with, or without extravasation of Blood. With extravasation, comes a *Tumor*, if not an *Apostеme*, which most commonly produces a Fever of uncertain Exacerbation; as is frequently observed in great Obstructions and Abscesses of the Lungs.

Having concisely recounted the Procatartic or Antecedent Causes of crude Matter apt to induce putrid Fevers, I must come to explain what I said of the *Aptitude* of crude Chyle received into the Blood, to corrupt it *Miasmate Febrili*. That I may do this with perspicuity and coherence, two things occur here to be considered. *One* is, *when* that supposed Aptitude or Disposition of Chyle imperfectly concocted, comes to be matured or exalted to an actual fermentation of the Blood: the *other*, *where* that crude Chyle is wont to lurk or lie concealed, until attaining to ripeness, it hath acquired forces sufficient to induce fermentation upon the Blood.

To the *FORMER* of these two questions therefore I answer, that crude Chyle, though from its first admission into the Blood it continually tend toward a febrile Ferment; doth yet notwithstanding rarely attain to that last Degree of depravity, where it meets

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not with an *Apparatus* of like matter before congeſted in the Body, ſufficient to augment its Forces, and ſerve for convenient Fewel to a Fever. For, it is by long experience found, that very few fall into any ſimply putrid Fever, unleſs after many errors admitted in the uſe of the ſix Non-naturals: nor is the febrile Ferment it ſelf wont, ſo ſoon as it is exiſtent in the Body to kindle a Fever, by breaking out into acts of open hoſtility upon the ſudden, bnt by ſecretly creeping on, as it were, and paſſing through certain degrees of operation ſucceſſively. Firſt, it is inſenſibly diffuſed through, and intimately commixt with the whole Maſs of the Blood, after the manner of other Ferments. Then inwrapping the vital Spirits by little and little with its clammyneſs, it diminiſhes their Agility, and diſpoſes them to ſloth. After this, it endeavours to inviſcate, bind, and as it were ſuffocate them; and then it is, that from their expanſive reluctation, the conflict and fermentation commences. All which may be collected from intermittent Fevers, at leaſt, if it be true (what many eminent Phyſicians hold) that the whole Febrile Matter that cauſes a Paroxyſm, is as it were burn'd out and conſumed in that Paroxyſm: as in an intermittent Tertian, there intervenes a whole day of vacancy from a Fever, and of quiet betwixt every two Paroxyſms; during which interval, the febrile Ferment is only diſpoſitive, and preparing to unite it ſelf intimately with the vital Spirits. But in a ſimple Quartan, two whole days intervene betwixt the precedent Paroxyſm and the Subſequent; the febrile Ferment all that while recruiting its Forces. From whence it is highly probable, that the crude matter doth not preſently produce a Fermentation, but by degrees, and by way of diſpoſition. Which may be ſufficient to ſolve the *firſt Queſtion*, viz. *When* the crudities commixt with the Blood come to acquire the

he degree of exaltation requiſite to induce an actual fermentation upon the Blood.

As for the *OTHER, viz. Where* the ſame crude Matter is wont to be congeſted, and to lye in ambuſh till that time; if the whole matter of the precedent Paroxyſm, be ſpent and conſumed in the Paroxyſm, as hath been ſuppoſed: then it neceſſarily follows, that the matter of the ſubſequent Paroxyſm, muſt either be generated anew, in the time intervenient betwixt the two Fits, or lie conceal'd ſomewhere in the Body, either in the Veſſels carrying the Blood, or out of them; from whence, as from its *Fomes*, it may after certain intervals of Time, ſally forth to infect the Blood and invade the vital Spirits. For both theſe, cannot be true; and therefore it remains to be inquired, which of the two is moſt likely to be ſo. My Opinion is, that the matter of every ſubſequent Paroxyſm is not *generated anew*; and my *Reaſons* are theſe.

(1) So ſoon as any Paroxyſm is ended, the very eſſence of the Fever Ceaſes for that time, and the Blood quickly returns to an *Apyrexia*. Now if the Cauſe be extirpated together with the Diſeaſe, nothing will be left remaining in the Body to continue it: and by conſequence, every new Paroxyſm will be a new Fever; which no experienced Phyſician, who hath obſerved the Diſeaſe to be of the ſame genius or nature from the firſt Fit to the laſt, will eaſily be brought to grant. (2) The ſame may be confirmed by this, that intermittent Fevers, even in poor Country People, frequently run through alll their times regularly, by degrees aſcending to their State, and thenceforth gradually tending to their Declination, when no Phyſician is called to Succour Nature: So that merely from diligent Obſervation of the motion of the Fever, a cer-

tain prognostication of the State and final cessation of it, may be collected, which would be impossible, if the matter of the Disease were every Day generated *de novo*: for who could foresee, when that new Generation would Cease?

(3) The cause of the Fever coming *ab extra*, is accidental, and depends on a less or greater Error committed in Diet, and is constituted *extra Febris essentiam*; nor can any *indication* be from thence desumed. And our *Dr. Glisson* affirms, that he knew a Man, who being of a strong Constitution, and afflicted with a *Tertian Intermittent*, obstinately abstained from all Meat and Drink, from one Fit to another; and yet could not thereby elude the return of his Fever. It may be therefore with good reason inferred, that putrid Fevers have an internal *Focus* some where in the Body, whence the material Cause of them breaking forth, and gathering fresh Forces, invades and irritates the Vital Spirits again and again, even till the *Fomes* be utterly exhausted and consumed.

There are (I confess) many great Wits, who in every intermittent Fever, seek for a *peculiar Fomes* or Seat of the Cause. I confess also, that sometimes such a particular and partial *Fomes* may be found; as for Instance, in the Stomach, or in the Pancreas, or in the Mesentry, and other Parts of the Abdomen; and an inflamation of the Lungs, is in some sort the *Fomes* of a *Peripneumonia*; an inflamation of the *Pleura*, the *Fomes* of a Pleurisy, and *sic de multis aliis partibus*: So that it cannot be denyed, but both intermittent and continual Fevers may arise from particular Seats; and that an Apostеme, chiefly an *Empyema*, may minister Fewel to a Fever; yea more, that an inflamation repercu'st from the outward parts, and a Gangrene in any the remotest Member of the Body, may produce

duce a continual Fever, by ſending forth corrupt matter to pollute and infect the Blood. All this (I ſay) muſt be confeſſed. And yet nevertheleſs it muſt be acknowledged, that beſides theſe particular *Fomites* of Fevers, there is a certain *General one*, common to all putrid Fevers: and this general *Fomes* I hold to be the very *Parenchyma* of the Parts nouriſhed out of impure Juices.

For this *FOMES* is of all others hitherto ſuppoſed, moſt conſiſtent with the Circuition of the Blood, by which it is commodiouſly carried to all Parts; and diffuſed univerſally: whereas other impurities can ſcarcely be ſo accumulated in the Solid Parts, but they muſt, when extravaſated, obſtruct the free courſe of the Blood. If they be ſuppoſed to ſtick, and be congeſted in the capillary Veſſels, or in the inconſpicuous Pores of the Parts; they muſt be a manifeſt and intollerable Obſtacle to the pertranſition of the Blood. If out of the Veſſels, they ſtagnate in the habit of the Parts, they muſt induce, not a Fever, but a *Cachexia*, or an *Anaſarcha*. Compelled therefore we are to fly to the very *Parenchyma* of the Parts; which in every putrid Fever are neceſſarily fuſed or melted by degrees, and being fuſed, as neceſſarily become Fewel to continue the Fever. For, in *continual* Fevers, the ſubſtance of the Parts amaſs'd out of Crude and impure Chyle, is *continually* melted, and ſo maintains the fermentation without intermiſſion, until all the Fewel be conſumed, and then the Fever is extinguiſhed. But in *intermittent*, the ſame impurities are melted by turns, or *Intervals*; and in every Paroxyſm, ſome portion of them is colliquated into a kind of *Sanies* or putrid Matter; which being remixt with the Blood, becomes, in a *Tertian*, the Fewel of a Paroxyſm to recur on the *third* Day from its Fuſion; in a *Quartan*, of a Paroxyſm

ysm to invade on the *fourth*; in a *Quotidian*, of a Fit to return on the *next* Day; *& sic de cæteris*,

And as to the *Duplication* and *Triplication* of these intermittent Fevers: 'tis probable, that when of a *Simple Tertian*, is made a *double* one, the Simple is not the direct Cause of the double: but the later arises from Causes like to those, from which the former took its beginning: So that a double Tertian may be rightly enough accounted to be *two single Tertians* alternately succeeding and complicated with each other. And the same, *mutatis mutandis*, may be said, with equal congruity, also of the origin of a double and treble *Quartan*.

But there remains yet another *Difficulty* greater than either of the two precedent; *viz.* concerning the *Suspension* of the Action of the crude Matter, to the time of the Paroxysm, in which it is actuated. That the State of which *Question* may be the better understood, let us (for instance Sake) suppose, that in a double Tertian, *A. B. C. D.* are four distinct crude Matters, melted and set afloate in the Mass of Blood in four successive Paroxysms. Let us suppose also, that this Fever first invaded the Patient upon Munday, and that in the first Fit, it melted so much of the crude *Parenchyma* of the solid Parts, as may suffice to produce a new Fit on Wednesday following. Let us suppose farther, that on Tuesday another Tertian began, and during that first Fit in like manner melted so much of the Crude *Parenchyma*, as may be sufficient to raise a second Fit on Thursday following. These things being supposed, the Question is, why the crude Matter *B.* melted on Tuesday, is not dissipated or corrected on the Wednesday following, when the crude Matter *A.* causing a Fit, is by the Fermentation rarefied, and expelled by Sweat: Why,

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I say, the Matter *B.* being remixt with the Blood all Wednesday, when the Matter *A.* was fermented, is not by that Fermentation corrected and dissipated at the same time; but suffered to lye dormant, and cause a Fit on Thursday following.

To untie this Knot therefore, I say, that the febrile Fermentation doth not much alter any crude Matter, that doth not yet *actually* impede the vital motion of the Blood. For, the Fermentation is regulated by the vital Spirits, which in the Case proposed, chiefly oppose and dissipate the Matter *A.* which alone by its clamminess actually hinders their expansive Motion. Hence it is, that in the Fermentation hapning on Wednesday, the vital Spirits are not much offended with the new Matter *B.* then melted and floating in the Blood, because it is not actually Febrile, nor doth it oppress them, so as to incite them to vindicate their Liberty by their expansive Motion. And thus the difficulty seems to be solved. ¶

*WHAT* hath been said a little before, of the general *Fomes* of all putrid Fevers, as well continual, as intermittent, *viz.* that it is in the very *Parenchyma* or Substance of the solid parts amassed out of crude or impure Chyle; may perhaps to some of my Auditors, long accustomed to the vulgar Doctrine of Physicians, concerning the Genealogy of Fevers, seem to be only precarious, and as easily denied, as affirmed: because it still remains doubtful, *how Chyle crude or impure can be, instead of good and laudable* Succus Nutritius, *or Aliment, converted into the substance of the solid parts.* To obviate this their doubting therefore before it settle into a prejudice more difficult to be removed; it concerns me to assert, that there is many times an *imperfect* Nutrition, or Vegetation and Augmentation, as well as a perfect,

fect, obſerv'd in the Bodies of Men; and conſequently, that the *Succus Nutritius*, or proxime Aliment of all parts, is either *pure*, i. e. perfectly concocted; or *impure*, i. e. imperfectly concocted. Whence it comes, that the Bodies of ſome Men are even vulgarly ſaid to be more or leſs *pure* than thoſe of others.

Thoſe few, who are ſo happy as to have Bodies in all parts *pure* and clean from crude and vitioſe humours, do not only from the right uſe of the ſix Non-naturals, enjoy perfect health; but have this farther advantage, that their ſolid parts not being augmented by the accretion of crude matter, they carry in them neither any *Febrile Fomes* congeſted in the habit of their ſolid parts, nor the leaſt diſpoſition to any other Diſeaſe. When on the contrary, *impure* Bodies, either through intemperance, or too full Diet, Surfeits, Compotations, and other Debauches and Diſorders; or from want of exerciſe to correct and diſſipate the crudities they have congeſted; are cramm'd and plump'd up with impure nouriſhment, and perhaps alſo augmented to an unprofitable and unwieldy Bulk. Theſe then muſt of neceſſity abound with a great ſtock of crude Matter, accumulated chiefly in the Subſtance of their ſolid Parts. Which when a Fever comes, from what cauſe ſoever, are melted by degrees, and dayly afford new Matter, to ſerve as prepared Fewel to the long and dangerous Fever, whether continual, or intermittent. But Bodies clean and pure, though perhaps liable to be ſurpriſed with a light feveriſh Diſtemper; are in much leſs Danger from thence: becauſe their ſolid Parts have not been imperfectly recruited with impure Nouriſhment; and conſequently the *Liquamen* of them is not ſo *Crude*, as to ſuffice to renew often, or long continue the *Fermentation*. From the Teſtimony of our very Senſes it is evident, that in all putrid

trid Fevers, the parts of the Body are more or less extenuated and colliquated: and that the Crude *Liquamina* of them are the material Causes of new Exacerbations in continual Fevers, and of new Paroxysms in intermittent, is highly consentaneous to reason. Hence it is, that Men recovering from long Fevers, if they manage their Health circumspectly and with temperance, attain to a renovation as it were of their Youth: because all the substance of their Parts, that was amass'd out of Crude and impure Matter, being by the Fever consumed, their Bodies are now repaired with pure and convenient Juices, such as abound with sweet Spirits duly exalted and excited by Concoction in the Stomach. Hence also we are led to a clear understanding of the true Reason of that *Aphorism* commended to our Observation by *Hippocrates*: *Si febricitanti, nec omnino leviter, suo in statu maneat corpus, nihilq; concedat morbo; aut hoc etiam plus æquo graciliscat, calamitosum: hoc enim ægri infirmitatem significat, illud vero diuturnitatem morbi.* For, the prognostic holds certain, *ratione tum causæ, tum signi.* If the habit of the Body be not extenuated in proportion to the Violence or duration of the Fever, the Cause must lye either in the abundance, or in the contumacy, that is the great viscidity or clammineſs of the crude Matter congested and affixt to the *Parenchyma* of the Parts: and therefore an observing Physician may from thence safely predict, that the Fever will prove of long continuance at best, if not fatal in the end. On the other side, if the extenuation be too great, it must come from the great force of the heat or fermentation in the Blood, that dissipates all things, not only the crude Matter preexistent in the habit of the Parts, but even the vital Spirits themselves, and the insite Spirits, that being intimately united

nited with the Vital, ſhould reinvigorate the Parts with Life and conſerve them. And therefore ſuch impetuous Extenuation, is likewiſe both cauſe and ſigne of extreme Calamity. *Exhauſtis enim ſupra modum & ſpiritibus, & partibus Solidis, omnis ratio pepaſmi deſideratur.*

All theſe Reaſons duely conſider'd, it muſt be granted that Bodies cannot poſſibly continue in all points pure and clean, if they be nouriſh'd with impure or crude Juices. Sound indeed and healthy they may be ſaid to be at preſent, becauſe they ſeem to foſter no proxime Cauſe of Sickneſs diſcernable by a Phyſician: and yet nevertheleſs, ſince they carry about Crudities ſecretly congeſted in the very ſubſtance of the ſolid Parts, which by occaſion of any light feveriſh Diſtemper, that would not otherwiſe laſt above a Day or two, may be melted and remixt with the Blood, and long protract that Diſtemper: we are obliged to acknowledg, that ſuch Bodies are really foul or impure, and contain in them a *Diſpoſition* to a Fever more or leſs remote. Otherwiſe it will follow that all Bodies actually ſound, are in reſpect of the habit of their Parts, either equally diſpoſed, or equally indiſpoſed to Fevers, and to the continuation of them: than which nothing certainly can be more falſe. For, have we not obſerved frequently, that Fevers, as well continual as intermittent, have in the beginning appear'd mild and gentle, ſo long as they were fomented only by Matter before contained in the Veins and Arteries: and yet afterward, when they began to be ſupplied with new Matter or Fewel from the colliquated Crudities that had been long congeſted in the habit of the Body, they have raged in extremity, and continued long before Nature, however accurately aſſiſted and ſuccour'd by our Art, could

could bring them to a *Crisis*? Conclude we therefore, that in putrid Fevers, there is no other *Fomes*, but the described Crudities, by long intemperance and other errors in Diet, congested in the babit of the solid Parts. For, these are in all putrid Fevers daily resolved or fused into a certain *Sanies* or corrupt Matter, and constitute a new *febrile Ferment*: which is the thing we have gone so far about to find.

But yet I must not omit to subjoin, that these *Liquamina* of the solid Parts imperfectly nourisht, are not confined within the narrow compass of *one* single *Genus*, but diffused through a large Field of indefinite *variety*. For, as indulgent Nature hath granted to us various kinds of *Aliments*, each of which is in its peculiar qualities or proprieties in some sort distinct from all the rest; and as the *Fuices* or *Tinctures* extracted from them by the concoctive Faculty of the Stomach, are in diversity respondent to the diversity of our Meats and Drinks: So must it be granted, that the *Crudities* after imperfect digestion admitted, first into the Blood, and then into the habit of the Body, and there affix'd to the solid Parts, and at length resolved into a certain kind of *Sanies*, that is most apt to afford Fewel to putrid Fevers (as hath been often affirm'd) cannot be all of a Sort, but some different from others, respectively to the different matters of which they were generated. And of these doubtless the variety is greater than can possibly be known by any Physician however curious; so far are we from hope to reduce them all to Computation. It were hard then for me, if any here present should exact from me an accompt of more of these obscure Differences, than what my present institute requires me briefly to explain: and all my learned Hearers will (I presume) be contented, if I do my devoir to

reduce them in general to the *Analogous Humors* of the Antients above described, namely *Choler*, *Phlegm*, and *Melancholy*; not pure or natural, but *Corrupt*. For, from *these Humors* taken in the Sense afore explicated, may be commodiously and congruously deduced, both the principal *differences* of putrid Fevers, and the most probable *causes* of those Differences.

First therefore, I must put you in remembrance of what I have more than once asserted, *viz.* That the Humors by this Hypothesis assigned to putrid Fevers for their Causes both antecedent and conjunct, are such which are not *exolete* or stale and despoiled of their Spirits, and grown vappid; but sufficiently *stored with Spirits*, noxious and infest to the vital mication of the Blood.

Then I with good reason suppose, that when the *Crudities* received first into the Mass of Blood, and after into the substance of the Parts, come neer to the nature of the *Serum* of the Blood, now corrupt, and by that putrefaction render'd acrimonious and well nigh Corrosive (which emulating the Bile contained in the Bladder of Gall, makes the *Choler* of the Antients) there is congested and prepared Matter most apt and disposed to produce *Bilious* Fevers, as they are call'd *Tertians*, either continual or intermittent.

That in case the congested Crudities neerly resemble the white and viscid *Grumus* of the Blood (which makes the Analogous *Phlegm* of the Antients) but corrupt: then there is laid up Fewel most convenient to foment *Pituitose* Fevers, *Quotidians* continual or intermittent.

That if it happens, that the Crudities congested be of such a Nature and Condition, as to be affine to the Analogous *Melancholly* of the Antients, *i. e.* to the *blackish Grumus* of the Blood, degenerate from its

its natural purity, and corrupt: then the Bodies carrying them about are obnoxious and prone to a *Quartan* ere long to invade them. And this may suffice to explain the Sentiments suggested to me by *Dr. Glisson*'s new Doctrine, concerning the most general and obvious Differences of Crudities apt to produce Fevers, so far forth as they may be taken for the *Conjunct* Causes of putrid Fevers. ¶:

I come then to the Fundament of the so often mentioned division of putrid Fevers into *CONTINUAL* and *INTERMITTENT*; that we may opportunely investigate, what that is, on which this remarkable difference seems immediately to depend. This in probability is nothing else but the very *Fermentation* of the Blood, in which alone the formal Reason of all Fevers doth consist; and which by vehemently exagitating the whole Mass of the Blood, sometimes *continually*, sometimes by *Intervals*, and those one while *certain* and *ordinate*, another while *uncertain* and *inordinate*; induces that Intense and afflicting *Heat*, in which alone the Antients have unanimously placed the essence of a Fever; and renders the Pulses of the Heart and Arteries *more frequent* than they ought to be; so that from thence alone, as from a Pathognomonic Sign, a Physician may certainly conclude of the presence of a *Fever*.

A continual Fever therefore is that which from the first Moment of its Invasion, to the last of its duration, continues and afflicts without Intermission, never coming in all that time to a perfect *Apyrexia* or utter Extinction. This Fever, if it be mild, gentle, unaccompanied with grievous Accidents or Symptomes, and but of one days continuance; is thence call'd an *Ephemera* or *Diaria*: if in like manner mild,

but of two, three, or four Days duration, it is denominated accordingly a *Diaria* of a few Days, or more properly, *Synochus Simplex*.

An *Intermittent* Fever is that, in which the febrile Fermentation doth not dure from the beginning to the end continually, but is *intermitted*, and returns with diverſe Paroxyſms after Intervals, now *ſhorter*, now *longer*: and theſe Paroxyſms running through their peculiar times, namely their beginning, augment, ſtate, and declination, there alternately, *i. e.* after the end of every ſingle Paroxyſm, ſucceeds an *Apyrexia*, not perfect perhaps, but *quoad Senſum*. From this viciſſitude, or rather from the various *Intercalation* of the Paroxyſms, various ſorts of intermittent Fevers have, for diſtinction ſake, obtain'd various *Names*. In particular, when a new Fit, in proportion reſpondent to the former, returns dayly, *i. e.* once in every twenty four Hours, the Fever is named an intermitting *Quotidian*. When a Paroxyſm recurs every other Day, or on every third Day, tis called a *Tertian*, and by the Vulgar, a *third-Days Ague*. When the Paroxyſm recurs not till after two whole Days of intermiſſion, 'tis call'd a *Quartan*, or *fourth-Days Ague*: and ſo forward; for there have been obſerv'd alſo *Quintans* and *Sextan's*, though very rarely. Here give me leave *en paſſant* to note, that the word *Ague*, by which the common People underſtand an intermittent Fever, is derived from the *French* adjective, *Aigù*, which ſignifies *Acute* or *ſharp*: perhaps becauſe an intermittent Fever is *acute* during the Paroxyſm at leaſt, and afflicts the Patient with *ſharp* Pains; though by Phyſicians, reſpecting rather the duration, than the vehemency of this Diſeaſe, it is number'd, not among acute, but among *Chronic* Fevers. How properly therefore the Engliſh call an intermit-

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tent Fever, an *Ague*, I leave you to judge, while I return into my way.

There is yet another *Species* of Fevers referrible neither to continual, nor to intermittent, but *compounded* of both kinds; which though it continually augment the natural heat of the Blood, nor ever comes to an absolute *Apyrexia*, no not so much as *quoad sensum*, before it be wholly judged or ended; and in that respect may pretend to a place among *continual* Fevers: yet hath certain *Exacerbations* and *remissions* of burning by intervals, and those sometimes every day, somtimes every third, somtimes only every fourth; and in that respect seems to belong to *Intermittent*. Hence it is, that such a Fever is call'd a *continual Quotidian*, or a *continual Tertian*, or a *continual Quartan*, according to the time of its *Exacerbation* or grieving anew.

Besides these three kinds of simple Fevers, Physicians have in all former Ages believed, that there are others, *compounded* of two or more intermittent. Of this sort are supposed to be.

(1.) *Double*, or *Triple Quotidians*; when on one and the same Day, two, or three Paroxysms invade, in proportion respondent each to other successively.

(2.) *Tertians double*, or *triple*; believ'd hitherto to consist of two, or three *Tertians*, whether in a double, two Paroxysms return in one Day, or single Paroxysms recur every third Day: or whether in a Triple, two Fits come in one Day, and a third on the next Day after; or three in one day, and none the next Day. An intermittent Fever of this sort is distinguished from a *simple Quotidian*, by the time of its invasion, by the time of its duration, and by the Symptoms that are wont to accompany it. For, in all these Circumstances, the *first* Paroxysm answers to the *third*, and

and the *third* to the *fifth*; but the *second* is respondent to the *fourth*, and the *fourth* to the *sixth*, and so forward. Whensoever therefore we shall observe this Analogy betwixt the Paroxysms alternately invading, we may with confidence pronounce, that the Fever is of that sort, which Physicians call a *double Tertian*. When we observe on the other side, that the first Fit is in all things like the second, the second like to the third, and so forward through the whole course of the Fever; we may certainly judge, that the Patient labours under a *simple Quotidian*. Besides these Characters of distinction, Physicians have recorded one more, and 'tis this: If a simple Tertian hath preceded: recurring every third Day, and after return every day; we may be sure, the Fever is of that kind, which heretofore hath been taken for, not a simple Quotidian, but a *double Tertian*.

Here perhaps ye will interrogate me about a *Simple Quotidian*, so frequently mentioned by me; namely, *Whether there be any such thing in nature, or not?* And ye have reason; there being a kind of Civil War among the Sons of *Æsculapius* upon the question. For, some of the Princes among them have with great eagerness contended to blot out of the Catalogue of Diseases, the very name of a *Quotidian*, as if really there were no such intermittent Fevers: and others no less renowned, as fervently, but somewhat more modestly, maintain, that of six hundred sick Men that suffer new Paroxysms every day, scarce one is afflicted with a *Quotidian*. I *answer* therefore, that true it is indeed, that a Quotidian hath been by some Authors, of great fame, banished into the darksome Island of *Chimæras*; but unjustly, and by those who being carried away by prejudice, and the authority of their Predecessors, rather than conducted by the light either of certain Experience, or of right

right Reason, have by their prevarication entangled their Followers in a gross and dangerous error: as I hope to evince, when I shall come to explain the causes of intermittent Fevers in particular; if what hath been delivered just now of the distinct signs of a simple Quotidian, be not thought sufficient to end the Dispute. For now I must hasten to the *third* sort of supposed compound Intermittents, *viz.* (3) *Quartans*, *double*, or *triple*. For as often as it happens, that a sick Man, remaining free from a Fit only one day, is afflicted with two new Fits on the two days next following: so often it is concluded, that he hath a *double Quartan*. And when a new Fit recurrs every day; but so, that the first Fit answer to the fourth, the fourth to the seventh; the second to the fifth, and the fifth to the eighth; in fine, the third to the sixth, the sixth to the ninth, and so forward: they conclude, that of a simple Quartan produced, first is made a *double*; and then of a double, a *triple* Quartan. And this seems to be confirmed (as *Sylvius* rightly observes) sometimes from the reason of *curing* such Fevers, *viz.* if one Fit be first taken away, and then on the two consequent days the Fits yet return, one day of intermission interposed; or if two Fits be taken away, one only remaining, and returning every fourth day: but more frequently from the symptoms, namely, the shivering, quaking, long-lasting cold, *&c.* which being more proper to Quartans, seldom occur in Tertians, and never but where the Tertians decline toward the nature and type of Quartans.

Besides all these sorts of intermittent periodical Fevers, there have been observed *others*, intermittent also, but of uncertain Periods; which they have therefore named *Inordinate* and *Wandering* or *Erratic*.

Having thus briefly run through all the most remarkable differences of putrid Fevers, simple and malignant,

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continual and intermittent, intermittent ordinate and inordinate, ſingle and double or triple; and deduced the cauſes of thoſe differences from diverſity of febrile Ferments operating upon the Blood, either without or with intermiſſion, by certain or uncertain intervals: purſuing the *Gliſſonian Hypotheſis* I deſign'd to aſſert and explain; it remains, that to prevent miſunderſtanding of what hath been ſaid of the *duplication* and *triplication* of intermittent Fevers, according to the vulgar doctrine of Phyſicians, as if I adhered thereunto; I repete what was before ſaid of that nice point: namely, that when a double or triple Intermittent follows upon the Heels of a ſingle, the ſingle is not (as hath been heretofore believed and taught) the direct cauſe of the double or triple: but the double or triple ariſes from the cauſes of its own, like to thoſe whence the ſingle at firſt aroſe. So that every double or triple intermittent ought to be accounted for two or three ſingle or ſimple intermittents of the ſame Species, alternately complicate among themſelves. ¶:

## *COROLLARIUM THERAPEUTICUM.*

MY *Pathalogic* diſquiſition being now at length ended, before all the Sands in my Hour-glaſs are fal'n down; I cannot (as I think) imploy the ſhort remainder of my time more profitably, than if I ſubjoyn a brief *Therapeutic Corollary*, pertinent to my precedent diſcourſe, and uſeful to Younger Students in Medicine; for whoſe inſtruction chiefly it was, that the wiſe and prudent Authors of the Statutes of this our ſo worthily renowned *Colledge*, firſt inſtituted and ordained *Anatomic*

*tomic Lectures* to be therein read by the learned *Fellows* thereof, whenſoever it ſhould ſeem fit to the venerable *Preſident*.

I will therefore do my devoir to explicate, wherein chiefly conſiſts that *Pepaſmus* or *Concoction* of crude Humors, which Nature, and her great Miniſter, *Hippocrates*, require to their opportune Evacuation in putrid Fevers; and by what kinds of *Remedies* the ſame may be beſt aſſiſted and advanced. For, theſe things being well underſtood, will afford much of Light toward the direction of the younger Sons of Art, in the true and moſt rational method of *curing* Fevers; in which no error can be little, no caution too great.

I begin from that never to be forgotten precept of the *Divine old Man*, afore recited: πέπονα φαρμακεύειν, καὶ κινέειν, μὴ ὠμὰ, μηδ' ἐν ἀρχῇσιν, ἢν μὴ ὀργᾷ: *Concocta medicamento purgare oportet, ac movere; non cruda; neq; ineunte morbo, niſi materia turgeat.* To which *Seneca* ſeems to have had reſpect, when he ſaid, *in morbis nihil eſt magis periculoſum, quàm immatura medicina:* and *Livy*, when he affirmed, *Medicos plus interdum quiete, quàm movendo & agendo proficere.*

The *Concoction* or digeſtion here meant, is by *Hippocrates* expreſſed ſometimes by the word πέπανσις, ſometimes by πεπασμὸς, to contradiſtinguiſh it from πέψις, which properly ſignifies the digeſtion of Aliment; as I have before advertiſed: and according to the general Notion of all learned Phyſicians, Antient and Modern, it is, *eorum quæ ſunt in corpore præter naturam, ad moderatam & ſecuturæ expulſioni percommodam temperiem deductio.* In which Senſe *Duretus*, the moſt faithful interpreter of the Oracle of *Cous*, expounds that place (*Lib.* 1. *Epidem. Anutii Foeſii edit. Pag.* 365.)

πεπασμὸς τῶν ἀπίοντων σκοπέεσθαι; *eorum quæ exeunt, concoctiones ſpectandas eſſe.* Upon which *Galen* copiouſly commenting, gives this memorable definition of the thing: πέψις γάρ τίς ἐστι τῶν παρὰ φύσιν, ὁ πεπασμὸς τὸ νοσήματος; *nempe coctio eſt quædam eorum quæ ſunt præter naturam, morbi maturatio.* And moſt rightly. For the Word πεπασμὸς, was *properly* uſed by the Græcians to expreſs the *ripeneſs* of the Fruits of Trees, by which they are advanced from the State of Crudeneſs or immaturity, to that of maturity or perfection; and *metaphorically*, to ſignify that maturity of the matter of Diſeaſes, which Nature by degrees induces, in order to the ſeaſonable and beneficial expulſion of it, when ſhe attempts a *Criſis* by ways moſt convenient.

Not that this Maturation is *always* to be expected in acute Diſeaſes. For we are to remember, there are two ſorts of *Crudity* of Cauſes apt to induce Fevers: *one* capable of being brought to moderation and ripeneſs; as that of the Blood in a *Phlegmon*, of the phlegm in a *Quotidian*, of Choler in a *Tertian*, *&c.* *Another*, incapable of correction and mitigation; as the Febrile Ferment that cauſes *Malignant* and *Peſtilential* Fevers, which being by its ſeminal Nature and unalterable Form, pernicious to the very principles of Life in Man, is ſometimes by the force of Nature expelled and utterly exterminated out of the Body, but never can be ſo changed and brought into ſubjection, as to be made leſs hoſtile to the vital Spirits that conſerve the Blood. And therefore in ſuch Fevers, wiſe Phyſicians are not wont to ſtay expecting Maturation of the Poyſon mixt with and fermenting the Blood, in the mean time loſing the Opportunities of relieving Nature by proper *Alexiterial* and *Sudorific* remedies.

To come then to the Marrow of the *Queſtion* propoſed.

posed. Considering: (1) That the Crudity of Humors inducing Fevers simply putrid, consisteth only in this, that the Spirits lodged in them are not sufficiently educed, excited, and prepared, so as to be fit to promote the vital mication of the Blood; (2) that all Fevers are essentially founded in the fermentation of the Blood; and (3) That the vital Motion or Heat of the Blood is always more or less impeded and perturbed, and often utterly extinguisht by that Fermentation: considering these things, I say, tis not difficult thence to infer, that the *Pepasmus* or *Concoction* requisite in all Fevers simply putrid, *i. e. not Malignant*, must consist chiefly in three things *è diametro* opposite to those now mentioned; namely (1) In the *Dissipation and Consumption* of the *crude Spirits* mixt with the Blood; (2) In the *Moderation* of the *Fermentation* begun; and (3) In the *Conservation* and *Corroboration* of the *vital Powers*. And these certainly are the three principal Scopes to which a Physician ought to direct his Counsels, in the cure of putrid Fevers; and which for their great importance, require to be singly explain'd.

To the *first* of these principal Scopes, *viz.* the *Dissipation* and *absumption of crude Spirits*, and requisite eventilation of the Blood by them inquinated, we may most commodiously attain, by fasting, at least by a thin Diet; by Remedies extenuating, acid, predatory and conducing to leanness; by Diaphoretics, Sudorifics, and by letting of Blood. For (1) *Fasting* tends directly to dissipation of the crude Spirits; because the Spirits, if not by intervals recruited out of new supplies of Aliment, must necessarily be soon exhausted and resolved into Air. But no mortal being able long to abstain from all sorts of Meat and Drink, or to endure absolute fasting; we are therefore com-

pell'd to ſubſtitute a *thin and ſpare Diet*, in the place of ſtrict abſtinence; for the moſt part thin Broths made of things moyſtning, cooling, not prone to corruption, ſubacid, and of eaſie digeſtion. To theſe (2) are added moderate and grateful *Acids*, apt to attenuate, reſolve and diſſipate the Crudities congeſted in the habit of the Parts, and therefore predatory. (3) *Diaphoretics*, which promoting inſenſible Tranſpiration, muſt conduce to the diſperſion and exhalation of the ſame Crudities. (4) *Sudorifics*, which do the ſame thing, but by a more expedite and conſpicuous operation, at once rendring the Crudities fluxile, and exciting Nature to drive them forth by Sweat. For Medicaments of this Family, by the tenuity and mobility of their Particles, penetrate the inmoſt Receſſes and ſlendereſt Pores of the Body, cut, attenuate and rarefie Humors into Vapors, and irritate the Parts to expel them together with the *Serum* of the Blood, in the form of Sweat. But in the uſe of theſe *Hidrotic* Medicaments great circumſpection is required, leſt the matter of the Fever, being not yet mature and prepared for this evacuation, be both importunely and with too much Violence exagitated, to farther corruption of the Blood, and increaſe of the Fermentation. So that they cannot be ſafely adminiſterd to impure Bodies, in the beginning, nor indeed in the augment, until certain Signs of ſome Concoction have been obſerved. (5) *Letting forth of Blood* by opening a Vein, which evidently detracts part of the Crude Matter floating in the Blood, and makes room for the remainder to be more freely fermented, and prevents eruption of the Blood out of its Veſſels into ſome noble part.

To ſatisfie the *Second* capital Intention, various things are required; *viz.* ſuch as may *facilitate* the Motion of Fermentation in the Blood; ſuch as may *moderate* the ſame,

ſame, when it is exceſſive in point of velocity; ſuch as may incite nature to quicken and *accelerate* it, when too ſlow; ſuch as may keep it within due Bounds, leſt it bring a dangerous flood upon any noble part. For, the motion of Fermentation is ſometimes too *turbulent* and tumultuoſe, and in that reſpect exceedingly *laborioſe*, requiring remedies to make it more ſedate and eaſie: ſometimes too *dull* and *ſlow*, and to be quickened; ſometimes it threatens a *Flux* upon ſome nobler parts, and then ought to be reſtrained. In particular, (1.) The *laborioſe* Fermentation (which the Ancients ſeem to have meant by the name of *Orgaſmus* or *Turgeſcentia*) indicates remedies apt to compoſe it, and render it leſs prone to moleſt and offend the Veſſels containing the Blood: ſuch as taking away ſome Blood by *Phlebotomy*, which by diminiſhing the Maſs, leſſens the burden of nature, and makes room for the freer Fermentation of the reſt; ſuch alſo are *Acids* and *Refrigerating*, and *Moiſtning* Juleps (not given actually cold, but lukewarm, nor in the leaſt vinoſe) all which allay the ebullition of the Blood, and make it leſs prone to be frothy. (2.) The *too ſwift* or vehement Fermentation, which makes the Fever more acute than the ſtrength and ſpirits of the Patient can well bear, and by conſequence ought to be moderated; requires remedies that may ſomewhat *retard* it, and procure a truce to nature, that ſhe may have reſpite to recollect and rally her Forces. Of which ſort are *Blood-letting*, *Anodynes*, *Hypnotics*, and ſometimes even *Narcotics*, either taken in the Mouth, or applyed outwardly to places convenient.

(3.) On the contrary, the *too ſlow* and lingring Fermentation, ſuch as cauſes *Lent* Fevers, calls upon the Phyſician for Spurs to incite and ſtimulate nature to accelerate the Conflict. In this caſe therefore he ought

to

to have recourse sometimes to *Purging* Medicaments, to be by Intervals repeated; sometimes to *Sudorifics*, and those pretty hot, efficacious, vinose or rich in spirits: for all these *quicken* the Fermentation, and dissolve the clammyness of the Febrile Matter, and in both those respects bring great relief to the Patient. (4.) The *Turgent* Fermentation, which threatens a Flux upon some noble part and imminent danger thereupon; directs to the speedy use of the best means for *Diversion*. Here therefore the most urgent Symptom is without delay to be opposed, by Remedies *Revellent*, *Divertent*, *Repellent*; as *Phlebotomy*, *Cupping-Glasses*, *Leeches*, *Ligatures*, *Vesicatories*, and other *Topics*.

In fine, the *Conservation of the vital powers*, is in putrid Fevers of greatest moment; because the Febrile Matter tends directly to the oppression of the vital Mication of the Blood, and the Fermentation it self proceeds no less from the Luctation of Nature, endeavouring to continue that motion in which life consists; than from the Ferment that hinders it. Hence it comes, that the lighter causes of Fevers are sometimes discussed by *Cardiacs* only, by a bitter decoction of Chamomil Flowers, and the tops of Wormwood, by *Carduus Benedictus* boiled in Posset-Drink, and the like *Euporista* or domestick Remedies. For, if the expansive motion of the vital spirits be so far assisted and corroborated, as to enable it to overcome the clammines of the febrile Ferment, that tends to the suppression of it; Nature certainly will soon obtain the Victory, and easily exterminate her Enemy. Here then is the opportunity of giving *Cordials* (as they are call'd) *Antidotes*, and *Specifics* or *Appropriate* remedies, vulgarly so named: all which conduce to the *Conservation* of the *vital Faculty*. ¶:

*BESIDES*

Besides the just now described preparation of the matter in putrid Fevers offending, to the opportune expurgation of it, there is required also a certain preparation of the *WAYS* or passages, through which the same is to be most commodiously carried off, that so the evacuation, whether by nature her self critically, or by her Minister the Physician artificially instituted, may be not only seasonable, but easie too and beneficial. For, these being, either by their *asperity*, or by their *narrowness*, or by *obstruction*, less passable than they ought to be; to attempt purgation, is vain and unsafe. Of which our Law-giver, *Hippocrates*, being fully conscious, left us this most prudent counsel (*Aphor.* 10. *lib.* 2.) Τὰ σώματα χρὴ, ὅκως ἂν τις βούληται καθαίρειν, εὔροα ποιέειν; *Si quis corpora purgare voluerit, meabilia ut reddat, est necesse.* But how is the Body to be made more permeable? By opening all the passages of it, and by cutting, dissolving and attenuating the gross and viscid humours that stick in them: which may be best effected, by Remedies *Lubricant*, *Abstergent*, and *Aperient:* the particular reasons of all which I shall endeavour briefly to explain.

(1) *Lubricantia* certainly render the ways more fit to give passage to humors that require purgation, by smoothing their roughness, and inducing instead thereof a manifest *slipperiness*; so that the humours slide along through them without any sensible renitency or attrition, which always causeth *Gripes* in the Stomach and Belly. Now of these Medicaments that are apt to induce slipperiness, some are simply *Aqueous*, and remove asperity only by their moisture, as Barley Water, thin Broaths, Whey, *&c.* Others are *Mucilagineous*, smoothing the ways with a certain friendly and pleasing Lentor, as the Syrups of *Althæa*, of the Flowers of Mallows, *de Mucilaginibus*, of Jujubs, *&c.* Others

*Oleagineous*,

*Oleagineous*, as Oil of ſweet Almonds, Linſeed Oil, freſh Butter, Lard, *&c.* Others, *Saline*, as the Salt, Cream, and Magiſtery of Tartar. Others, *Spirituoſe*; as New-laid Eggs, but little boiled, the Pulp of ripe Fruits. Again of theſe, ſome *looſen* the Belly alſo; as the Pulp of *Caſſia* and *Damaſco* Prunes, which above all things contemperate the roughneſs of purging Medicines, being for that reaſon chiefly admitted into the compoſition of the *Diaprun. Solut.*

(2) *Abſtergentia* ſeem to have the like good effect, in facilitating the operation of purging Medicaments; as Soap hath in cleanſing of Linnen. For, whatſoever ſticks to the inſide of the Stomach and Guts, they wipe away; and are found, in that reſpect perhaps, to conduce much to the correction of ſtrong and churliſh Cathartics; by preventing their rough and grating Particles from pertinaciouſly adhering to the Coats of the Ventricle and Inteſtines, and ſo inducing Gripes and Contorſions. Hence 'tis familiar to Phyſicians to tame fierce Purgers with Salts, *viz. Sal Gemmæ*, Salt of Tartar, of Nitre, Spirit of Vitriol, and of Nitre dulcified, *Cremor Tartari*, and the like. Not that they confer to the bridling of the fierceneſs of ſtronger Cathartics in this name only, but becauſe they are uſually preſcribed chiefly to this end.

(3) Nor are *Aperient*, i.e. cutting and attenuating Medicaments of leſs utility in this buſineſs, where the ways through which peccant humours are to be educed, are obſtructed by any vitioſe matter cramm'd into them. For, remedies of this *Claſſis*, by reaſon of the great tenuity, acuteneſs and agility of their Particles, penetrating into the ſmalleſt Veſſels and Pores, and attenuating viſcid and tenacious humours therein ſticking, open all paſſages in the Body. No wonder then, if by rendring the clammy matter of Fevers more thin, fluid, and

and more obedient to nature endeavouring, upon irritation by Purgers, to expel it; they conduce mightily to the more facile, and more successful operation of Purges. Nevertheless, we are to advert, that not all sorts of humours are to be made fluxil, before any be exterminated by artificial purgation: but that we are, in pertinacious obstructions of the *Viscera*, to act with *Aperients* and gentle *Cathartics* by turns. For, as there are degrees of Concoction, so likewise ought there to be degrees of evacuation; and so soon as any part of the peccant matter is concocted and prepared; we must attempt to carry it off; to the end that nature being thereby exonerated of part of her Load, may with more facility digest the Remainder; at least when we perceive her to be oppressed by too great weight. Of *Aperients* some are *hot*, which ought to be administred to Men of robust Bodies, and cold complexion, and such as labour of inveterate Oppilations: some *cold*, which are proper for persons of hot constitutions, and prone to abound with Bilious or Choleric Humours: others *Temperate*, and therefore most convenient to tender, soft, delicate and crazy Bodies. But these three sorts being judiciously contemperate, mutually refract each the others qualities, so as to reduce them to mediocrity. Other differences of *Aperients* there are, which I must lightly touch. *Some* remove Oppilations by *attenuating simply*, without the least of Astriction; as the five opening Roots, the Bark of Tamarisc, and of the Roots of Capers, the Leaves of Maiden-hair, Hearts tongue, Ceterach, and Fern Roots, *&c.* *Others* both *open*, and *moderately bind*; as Endive, Cichory, Agrimony, Rhubarb, Sage, *&c.* *Others* again are endowed with an aperitive faculty, but are withal *vehemently astringent*; as Steel, which hath no fellow. Now, as to the seasonable *use* of these differences; in the *beginning*, Aperients

rients without Astriction are most convenient, because they best dispose the humours to fluxility, and clear the passages: yet are they to be prescribed with this caution, that the tone of the parts be not by the importune use of them dissolved, or irritated to a cruentation. The safer way therefore is, to mix with them one or two of the *second* Tribe, that have somewhat of Astriction in them. Aperients *moderately astringent*, are indeed in themselves most safe; but they are given with best success after a general Evacuation. And more *vehement Astringents* are to be kept in reserve, to *finish* the cure, by restoring the weakned parts to their pristine tone and vigor.

But is it not plainly dissonant to reason, ye will say, that the same remedies should be at once both *Aperient* and *Astringent?* I *answer*, therefore, with Doctor *Glisson*; that *Aperients* and *Astringents* are not directly *opposite* each to the others. For, the contraries to *Aperients* are *Obstruents*; and to *Astringents*, *Laxants*. Besides, in a Cachexy and Dropsie, which either proceed from, or are commonly accompanied with great Obstructions; the natural tone of the parts is always relax'd more or less. It must be confessed indeed, that in those maladies the tension of the Nerves is for the most part too great, by reason of their continual irritation by vitiose humours: but nevertheless it cannot be denied, that their natural tone is less firm than it ought to be. If therefore *Obstruction* may consist with *Laxity*, why may not *Deoppilation* as well consist with *Astriction?*

And thus have I run over the three principal things prærequisite to Evacuation in putrid Fevers, *viz*, correction of the peccant matter, conservation of the vital Mication of the Blood, and permeability of the ways. It remains only, that I adjust what hath been said

ſaid, to a certain Rule of *Hippocrates*, that ſeems to render it doubtful. The precept is this (*Aphor.* 29. *lib.* 2.) Ἀρχομένων τῶν νόσων, ἤν τι δοκῇ κινέειν, κίνει; *Ineuntibus morbis, ſi quid movendum videatur, move*: Which ſome perhaps may think plainly repugnant to the former Aphoriſm, upon the explication whereof I have ſo long inſiſted.

To reconcile therefore theſe two equally true Aphoriſms, I muſt acknowledge, that it is *not always* requiſite to expect a *Pepaſmus*, or maturation of the Morbific Matter in Fevers ſimply putrid. For, there are various caſes, in which whether they happen to be ſingle, or concurrent; the counſel of this latter Aphoriſm is to be preferred to that of the former. And all theſe Caſes may be reduced to the number of five.

The *FIRST* is, when any vitioſe humor, either by its abundance, or irritating quality, or motion doth moleſt the patient, in the firſt region of the Body, that is, in the Stomach, or Guts, or Panereas, or Liver, *&c.* which requires to be ſpeedily expelled upward or downward. For 'tis not to be doubted, but that a Phyſician may, and ought, in this caſe, to relieve moleſted nature, as ſoon as is poſſible, by carrying off the irrequiet humor [διὰ τῶν ξυμφερόντων χωρίων] by ways moſt convenient. And by the Oracle of frequent experience we are taught, that not only intermittent, but continual Fevers alſo, are much diminiſhed, if not totally eradicated by ſafe Vomits or Purges adminiſtred in the beginning. For, the fovent cauſe being taken away, the proxime cauſe is much more eaſily diſcuſſed; which ſeems not to be any humor ſtagnating or congeſted, either in the *Viſcera* themſelves, or in their Confines, as hath been already ſhewn; but floating in the Maſs of Blood within the Arteries and Veins. This therefore is not to be attempted by any purging Medi-

cament, until Concoction hath preceded: and the *latter* Aphorism advising Purgation in the beginning of putrid Fevers, is restrained to crude humors contained in the first Region of the Body; nor doth it respect the times of Diseases, so much as the strength of the sick, (which is very rarely exhausted in the beginning) according to the judgment of *Galen* (*libr. ad Thrasybulum, cap.* 38.) who gives this reason of the Aphorism, *Quòd natura, adhuc satis valida existens, detractâ oneris quo premitur, parte, quod reliquum est & facilius ferre, citiusque concoquendo mitigare possit.* Hence it is, that not only *Glysters*, that rinse the Guts, but gentle *Solutives* also, such as may without any great tumult or commotion carry off any vitiose humor lodged in *primis viis*; are commended by the most experienced Physicians in the beginning of putrid Fevers.

The *SECOND* Case is, when any matter incapable of mitigation by Concoction, begins to shew its *Turgescence*, i.e. either from its abundance, or from its malign quality, flying from place to place, induceth a frequent mutation or shifting of Symptoms: all which *Hippocrates* comprehended in the word ὀργὴ, which signifies *rage* or *fury*. Which for the most part happens in the beginning of the Fever; and then arise various Symptoms, and dangerous, according to the various Temperament, Irritability, Action, Use, and Situation of the part upon which the turgent matter rusheth. As for instance, in *Phrenetic* Patients we observe an admirable change of Symptoms; sometimes their Sight, sometimes their Hearing, sometimes their Tongue being invaded and disordered by the wandering humor that causes their *Delirium*, and often shifts the scene of its tragical fury. And the Reason seems to be this, that the inraged matter of the Disease is so highly offensive to Humane Nature, that no part of the whole

whole Body can ſuffer it ſo much as one moment of time, without uniting the Forces of all its irritated Fibres to ſqueeze it out, ſo that it is tranſmitted from ſome parts to others in a trice. If it happen therefore, that any crude humor be in this impetuoſe manner tranſmitted to any *Secretory* Organ (even though it be not redundant in the whole Body ( a conſiderable part of it may be, by help of purging Medicaments, reſpective to that Organ, ſpeedily carried off to the preſervation of the Patients life. For, the humor, ſo turgent, and ruſhing into the Organ, doth by its very motion irritate the Fibres of it to contract themſelves vigorouſly to expel it; no leſs than if it were redundant in the whole Body. If the ſtorm then fall upon the *Stomach*, the danger thence impendent may be eaſily prevented by a moderate *Vomit*, given before the humor be removed to ſome other part; if upon the *Guts*, a convenient *Purge* may ſerve to turn it downward. And yet I muſt confeſs, that ſuch early Evacuations are commonly tumultuous and painful; as promiſcuouſly educing all humors they meet with; and therefore never to be inſtituted, but where the matter of the Diſeaſe is turgent.

The *THIRD* Caſe is, when ſome little portions of any one, or more of the *Analogous* Humors formerly deſcribed, chance to be carried, together with the ſtale and dead recrements of the Blood, to the *Secretory* Organs. In particular, when ſome of the acrimonious and corroding *Serum* of the Blood, is by nature therewith offended, tranſmitted, together with the *Bilioſe* Excrement of it, to the *Liver*: or ſome of the whitiſh and viſcid *Grumus* of the Blood, together with the *Pituita emortua*, to the *Stomach*; or finally, ſome of the *aqueous* or potulent matter, with that of the *Urine* to the *Kidneys*. Becauſe Nature tends that way, and being;

ing assisted by a convenient *Purge* in the *first* Case; in the *second*, by a gentle *Vomit*; and by temperate *Diuretics* in the *third*; may continue the same course, until she has brought the remainder of the peccant matter to a perfect *Crisis*.

The *FOURTH* is, when any vitiose matter yet crude, is so redundant in the Blood, that nature, reduced to her last shift, is compelled to exclude it by parcels, by any *Secretory* Organ, not by that which is most proper and congruous to the nature of the humor. As it happens in the *Yellow Jaundise*, when part of the corrupt *Choler* is separated from the Blood in the Kidneys, and makes the Urine thick, turbid and yellow: and in that dreadful Disease call'd *Cholera*, all the *Bilis* ejected upward and downward, is not concocted and truly felleous, but for the greater part crude and only analogous to that which is separated from the Blood in the Liver, and thence brought into the Bladder of Gall, and seems to be generated by a certain malign or venenose corruption of the Blood. For, improbable it is, that so prodigious a quantity of bilious matter hath been separated, in so little time, by the Liver, or excreted by the *Porus Bilarius*; but most probable, that the same is separated from the whole Mass of Blood in the inmost Coat of the Stomach and Guts. In like manner, they who drink Mineral Waters, or Wine profusely, make Urine indeed in abundance, but thin and crude.

The *FIFTH* and last Case is, when the Febrile Fermentation appears to be slow and lingring. For, here 'tis lawful, by just intervals, to ordain Evacuations by milder Cathartics; not only in respect of the *Focus*, which in such Cases is wont to be recruited often, and therefore requires to be substracted by repeted Evacuations; but also that the Fermentation it self may be

be quickned, and so nature excited to perform her work of digesting the Crudities with more vigor and expedition. Besides, since in lent and lingring Fevers, the crude matter is not brought to the state of maturation all at once; but first some part, and then more and more successively: 'tis fit the same should be evacuated *per Epicrasin*, or part after part accordingly: and this, lest that part of the matter that is first digested, remain still mixed with the Blood, and inquinate it; or at least, being separated in the inmost Coat of the Stomach and Guts, pervert either the Concoction or Distribution of the Chyle, and so foment the Disease.

And thus have ye at length succinctly set before you all the *opportunities* in which it is not only lawful, but expedient for a Learned Physician, directing his judgment [ κ τὴν τέκμαρσιν, as our Master *Hippocrates* speaks ] by certain observation of Signs and Symptoms in the sick; to institute convenient Evacuations, at least by milder purging Medicaments, even in the beginning of putrid Fevers. Nor doth any thing else remain for me now to subjoyn concerning this Argument; but this brief *admonition*, that no young Practitioner be so rash, as to purge, where he finds not one or more of these opportunities offered to him. For, if he attempt *crude* matter by strong and fierce *Catharticks*; 'tis ten to one, but he will exhaust much of the vital spirits, colliquate the Blood, and render the Disease mortal. ¶.

CONCLUSION

## CONCLUSION ANAGNOSTICK.

'Tis the cuſtom of Travellers (ye know) when they have with panting Breaſt, and painful Steps, aſcended to the top of a ſteep Mountain, to turn about, and look back upon the places and ways they have with ſo much labor and patience paſſed: and this, not only to take breath a while, but to imprint more deeply in their memory, the Images of whatever things they had *in tranſitu* obſerv'd; uncertain whether or no Fortune may ever bring them that way again. Let us then (moſt *judicious*, and moſt *candid Auditors*) who are all *Travellers* too in the moſt darkſome and rocky ways of Natural Knowledge, follow their Example; and having now at length attain'd to the end of this Mornings Journey, take a ſhort review of the things offered to your notice, as we paſſed along: to the end ye may the more eaſily recall them to mind, whenever ye ſhall be pleaſed to think them not altogether unworthy your *Examen*; it being unlikely, that I ſhall at any time hereafter have the honour to ſerve you, in the quality, not of a Guide, but *Torch-bearer* in this place.

*The Heads therefore of the various things propoſed by me to your conſideration, are theſe. I ſhewed in the firſt* Stadium,

(1.) That the *vital motion* of the Blood is ſometimes diſordered, impeded, and impugned by cauſes *præter-natural*

*natural*; and chiefly by *crude* humors conſtituting a peculiar *Fermentative Inquinament* of the Blood: and that from thence ariſes a duel or conflict between the *vital ſpirits*, on one ſide, and that *Inquinament* on the other; which conflict, in putrid Fevers, is call'd by the Ancients, *Putrefaction*; and *Fermentation*, by the Moderns. (2.) That the ſame Ferment, in Fevers, tends naturally to the *oppreſſion* of the vital Mication of the Blood, in which life it ſelf immediately conſiſts. (3.) That the *crudity* of humors generating that Ferment, and conſequently Fevers, doth conſiſt chiefly in this; that the ſpirits of our food receiv'd into the Stomach, either have not been by the concoctive faculty thereof ſufficiently *exalted* (which always happens in Fevers *ſimply putrid*) or though excited, have not been *ſubdued* and *tamed*, ſo as to become uſeful and fit to promote the vital Mication of the Blood (which always happens in *Malignant* Fevers. (4.) That the principal reaſon, why in putrid Fevers it is unſafe to purge, before nature hath *concocted* the crude matter mixed with the Blood, ſeems to be this; that in the whole Body are no *Secretory* Organs deſtined peculiarly to the ſeparation of humors yet crude, from the Maſs of Blood. (5.) That the *Analogous* Humors of the Ancients are coincident with the Elements, by the Moderns ſuppoſed to conſtitute the Blood: and that it is plainly neceſſary, that in every Fever, of whatever ſort, ſome one, or more of thoſe Analogous Humors be in fault. (6.) That the formal reaſon of a *Malignant* Ferment is radicated in ſome *ſeminal nature* pernicious to the principles of Life in Man.

*In the Second,*

(1.) That the *oppreſſive Energy* of the Febrile Fer-

ment described, comes immediately from the *pendulous Lentor*, or clamminess of it, by which it is apt to render the Blood foul and *roapy*, and to inviscate the vital spirits, that should by their expansive motion conserve its purity. (2.) That these vital spirits are incited to raise a Fermentation, not by the exhalations of the Blood retained, but only by the said *clamminess* of the crude matter inducing the Fever.

*In the Third,*

(1.) That the *Symptoms* contingent in the *beginning* of a Febrile Paroxysm, may be most commodiously referred to the aforesaid *Conflict* or Colluctation betwixt the expansive endeavour of the vital spirits, and the opposite clamminess of the Febrile Ferment. And (2.) that the *Symptoms* succeeding in the *Augment*, *State*, and *Declination*, may be with equal congruity solved by the same Hypothesis.

*In the Fourth,*

(1.) That the cardinal *Differences* of Fevers are most probably derived from the *Different Ferments* that induce them immediately. (2.) That the *Origin* of all Fevers, simply putrid, *i.e.* free from all Malignity, may be most congruously deduced mediately from *defect*, either of *Chylification*, or *Transpiration*, and *free motion* of the Blood, whether this happen with, or without extravasation thereof. (3.) That the Blood, when inquinated by crude Chyle, doth not presently conceive a Fermentation, but after some time, and *by degrees*. (4.) That in *intermittent* Fevers, the matter of each single Fit is not generated anew; but comes from a *general Fomes*, existent in the very *substance* of the solid parts

parts imperfectly nouriſh'd with crude juices. (5.) That this very ſubſtance of the ſolid parts is melted into a kind of *Sanies* or putrid matter, and remixt with the Blood, in all putrid Fevers. 6. That the *Analogous* Humors of the Ancients, reſult from various *Crudities* mixed with the Blood: and that from thence ariſe various ſorts of Fevers; namely, *bilioſe*, *pituitoſe*, and *melancholic*. (7.) That the diviſion of Fevers into *continual*, and *intermittent*, doth immediatly depend upon the Fermentation, ſometimes continual, ſometimes ceaſing and recurring diverſly by intervals. (8.) That an intermittent Fever *ſimple*, is not the direct cauſe of an intermittent *double* or *triple*.

*In the Fifth, and Laſt,*

(1.) That to the *Maturation* of the crude matter, are required three things, *viz.* Diſſipation and Conſumption of the unexcited ſpirits therein remaining, Moderation of the Fermentation already begun, and Conſervation of the Vital Faculties. (2.) That in order to ſafe and opportune *Evacuation* of the ſame peccant matter, is required alſo due preparation of the *Ways* or Paſſages, by which it is to be educed; and that by Remedies *Lubricant*, *Abſtergent*, *Aperient*. (3.) That ſometimes even in the beginning of putrid Fevers, *Purgation* is requiſite; ſpecially when vitious humors moleſt in the firſt Region of the Body, or when the Febrile Matter is turgent, or when part of it is tranſmitted, together with the ſtale Recrements of the Blood, to any one or more of the three Secretory Organs; or when Crudities are highly redundant in the Maſs of Blood; or finally, when the Fermentation it ſelf is too ſluggiſh and lingring: but in no other caſe whatſoever.

And this, *moſt candid Auditors*, is the Sum of what

hath been in this Seſſion ſaid concerning *Fevers*. Nor have I any thing more to add, but only this; that if I have, by offering you this Abridgement, uſurped the Office of your *Anagnoſtes*; it was not from a vain conceit, that the poſitions therein contained, are worthy *your* belief: but only from hopes, that ye might be thereby more eaſily inclined, to let me underſtand from your judgment of them, how far they may be worthy *mine*. For, in this Argument, (as in all others, whether *Phyſical*, or *Pathological*) I pretend not to know truth, but to *ſeek* it: nor to ſeek it contumaciouſly and arrogantly, but *modeſtly* and *doubtingly*; as becomes a *Man*, a *Philoſopher*, and a *Fellow* of this Royal Colledge of Phyſicians, into which I entered with no other ambition, but that of being more and more inſtructed in *Natural Science* and all other *Virtues*. ¶.

PRÆLECTIO

# PRÆLECTIO VI.

## OF MOTION VOLUNTARY

IN the beginning of time, when it pleas'd the Divine Majesty to call this visible University of things, the World, out of nothing, and to create Subjects whereon to exercise his infinite goodness; having indowed all living Creatures with *Appetites* requisite to the conservation of their peculiar Beings; and accommodated them with *Objects* proportionate to those Appetites: He saw it convenient, to consummate that Emanation of his Bounty, by furnishing them also with *Faculties*, by which they might be impowerd, not only to discern what Objects are good or convenient, what evil or inconvenient to their particular Natures; but also to *pursue*, or *avoide* them accordingly. Now, among these so necessary Faculties, *that* by which all Animals are inabled to prosecute what is presented to them under the appearance of Good, and to eschew what they apprehend to be Evil; is what Physiologists call Δυναμιν κινητικην, the faculty *LOCOMOTIVE*; and rightly enough define to be, the Power by which a "living Creature is inabled to move or transferr "from place to place, either is whole Body or any Part thereof at pleasure. To

To the putting this noble Power into Act, are required as absolutly necessary, besides the Member or part of the Animal to be moved, three things; which according to the Order of their Succession, are,

(1.) The Object, ὀρεκτὸν (as *Aristotle Lib. de communi Animalium motu cap.* 7. terms it) τὸ ὀρεκτὸν, that which *Invites*; or τὸ φευκτὸν, that which *Offends*.

(2.) The *Efficient*, call it what you please, the Soul, Mind, or Intellect, in Man; the Imagination, Phantasie, or Brain, in Brutes; or Locomotive, Animal Faculty, in both: which being invited, or offended by the Object, moves the whole Body; or some Member of it, in pursuance or avoidance thereof: and,

(3.) the *Instrument* used by the Efficient; which seems to be double: *viz. Mediatum*, that, by the mediation or intervention of which the Appetite, Soul, or Imagination doth as it were dispense its Command, and Communicate Virtue motive to the Organ to be used: and *Immediatum*, that by which immediately the Command given is executed, and the intended Motion performed.

As for the Necessity of the *first* and *second* of these three requisites to animal or voluntary Motion; I think it needless for me to insist upon the explication thereof: because it is most evident, and on all Hands confessed, that the *Soul*, whether Rational, or Irrational, is the *primary Agent* in all voluntary Motions; and that the same is thereunto incited by the good, or evil appearing in the Object.

But as for the *Instrumentum mediatum sive primum*, that upon which the Soul or Appetite immediately acting, doth by the help thereof produce a Motion, first in the *ultimate Instrument* (which undoubtedly

is

is the *Muscle*) and then in the Member, whose Motion conduces to the attainment of its end; it is a *Question*, and a great one too, whether there be in truth a *necessity* of any such thing, or not.

The *Antients* (tis well known) unanimously taught, that the Soul effects Motion in the Muscles, at pleasure, by transmitting from the Brain, by the Nerves, into them, a certain most thin, most subtil, and most agil Substance, (which they call therefore *Animal Spirits*) by whose swift and copious Influx the Muscles to be moved being in an Instant as it were inflated and distended *Secundum latitudinem*, they are forced to contract or shorten themselves *Secundum longitudinem*, and by that Contraction to pull and move the Members to which they are fastned. And this Opinion hath been without any dispute embraced and asserted, through a long train of Ages, down to this in which we live.

But in this our more illuminate Age, Fate has brought forth some Physicians of this Nation and Colledge, of most profound Learning, and admirable sagacity of Spirit; who laying aside that so antique Hypothesis of *Animal Spirits*, as both improbable and unnecessary: hold it to be sufficient to solve all the *Phænomena* of voluntary Motion, if it be supposed, that the dictates of the Soul are transmitted from the Brain to the Nerve and Muscle to be used, not by emission of any Substance whatsoever, but by a mere contraction of such Fibres of the Brain as are continued to that Nerve. For the Nerve (say they) having its origin from the Fibres of the Brain, and being at one end continued to them, at the other inserted into the Head of the Muscle; so as to make one continued Cord all along: if a Motion be excited, *ad nutum animæ*, in the Fibres of the Brain, the same must

must be at the same time excited in the Nerve also and in the Muscle, by reason of their *Continuity*.

Betwixt these two so different and irreconcileable Opinions, I am forced to suspend my Judgment, not yet able to discern, which hath the advantage above the other, in point of Verisimilitude. To reject *either* of them, as *Erroneous*; would hardly consist with the modesty of a Philosopher, who cannot but be conscious, and ought to confess, how abstruse a thing the nature of a Soul is; how imperfect and confused the Notions are, that Men have formed of their own Mind; and how extremely difficult it is for human Reason to compose a congruous and satisfactory Discourse, concerning the Oeconomy of the Brain in a living Creature, which is as obscure to our understanding, as the Effects of it are manifest to our Senses. To reject *Both*, because they are both embroyled with many Difficulties, some of which seem to me to be insuperable; were to make my slender Capacity the Measure of Probability, to prefer the horrid darkness of Midnight to the hopeful dawning of Light in the Morning, and to oblige my self to excogitate some *third Hypothesis* less liable to incongruities and Objections, which is above my Power. What then remains for me to do in this perplexity of Thoughts? Only this, to bring the whole Cause to the tribunal of your Judgment, *Most wise and most equal Arbiters*, there to be finally decided. I resolve therefore, by your Leave, to handle this weighty controversie, *tanquam problema utrinq; disputatum*; and while ye hold the Beam of the Balance, to put into the Scales the principal Arguments alleaged on both Sides, together with their respective difficulties not yet sufficiently solved: to the end, that ye may, afer due perpension, give Sentence, which

of

of the two Opinions is the more probable.

I begin from the *FORMER*, out of respect to the Antients; assuming to myself, *pro tempore*, the Person of a Defendant of Animal Spirits, as the immediate instrument of the Soul in voluntary Motion, in Man.

In the *first* place, therefore, I say; That seeing every Instrument ought to be accommodate, both to the nature of the Agent that is to use it; so as to hold some proportion to the Energie of the one, and to the Conditions of the other; and seeing that voluntary Motion is commanded and executed in one and the same moment of Time, with Velocity equal to that of Lightning: considering this, I say, it seems necessary, that the Instrument upon which the Soul immediately impresses her Power motive, should be such, as is naturally fit to convey the same from the Brain, by the Nerves, into the Muscles, *tanquam in instanti*, and most easily. But in the whole Body nothing is found so easily and swiftly moveable, as that most subtile and meteoriz'd Substance, of which the Spirits Animal are supposed to consist; and therefore it is consentaneous, that they are the immediate Instrument of the Soul in voluntary Motion.

Here I foresee it will be *Objected*, that although these Spirits be supposed to consist of Matter the most refined, and most agil imaginable, more subtil than the Particles of Light, or *Des Cartes*'s *subtilis materia*; yet still they must be *Bodies*, and therefore can hold no conceivable proportion to the Soul, which is believed to be *Incorporeal*. Nor indeed am I so vain as to hope ever to hear this Objection fully Solved. Nevertheless I take liberty to observe, that it lies as heavy upon the other *Hypothesis* of the Muscles being moved by the Nerves excited or invigorated at

their original by Motion, begun in the Fibres of the Brain, by the Soul: it being no less difficult to conceive, how an *incorporeal Agent* can Act upon a *Corporeal Organ*, by way of simple contact or impression than how it can communicate a forse by Tranemission of Spirits most subtile, most active: nay more, I may adventure to say, this latter supposition is so much the less inconceivable than the former, by how much more easily a most *light* and most *agil* Substance is put into Motion, than a *heavy* and *gross* one.

*Secondly*, evident it is, that the motive Power of which we are speaking, is not inherent in the Muscles themselves, nor in the Nerves inserted into them; but derived and immitted into them from the Brain, *ad nutum animæ*, as she has occasion to use them. If so, what notion can we have for such a Power, unless we conceive it to be a certain invigoration or force, suddainly communicated to, or impress'd upon the Fibres of the Muscles? and wherein can we imagine that invigoration to consist, if not in a distention of those Fibres, by some influx from the Brain? This very consideration seems to have induced that great Man, *Galen*, to deliver this for an undoubted truth (*in lib. de motu musculor. cap.* 2.) *Adeo certè magna quædam vis est in nervis, supernè à magno principio affluens: non enim ex seipsis eam, neq; connatam habent*, &c.

*Thirdly*, if there be no invigorating Influx from the Brain through the Nerves; how comes it, that an Obstruction, or Compression of any one of them forthwith causes a *Palsy* in that part, to which the obstructed or compress'd Nerve belongs? Is it not only from hence, that the intercourse betwixt the Brain and Muscles of that part, is wholly stopped? If the Nerves were designed and fraimed by Nature to do the office of *Strings* or *Cords* only; why were they not made

made of one continued Substance, but of many slender Filaments or Threads? And why were not these small Threads closely twisted together into a strong Cord, but extended, as parallels, side by side, and intercepted with many narrow *Canales* or passages betwixt them, and all inclosed within a membraneous Coat extremely thin and tender? Certainly, if we attently contemplate the artifice of Nature, in the Figure and contexture of a Nerve; we shall find our selves almost obliged to acknowledge, that the *Fibres* were so disposed in Parallels, with small *Canales* running along betwixt them, to give free and quick passage to the subtile influence to be transmitted from the Brain into the Muscles, for the invigoration of their Fibres. And *Galen* reflecting upon this, that if a Nerve be cut asunder, the Muscle into which it was inserted, becomes ever after incapable of being used to voluntary Motion; from thence with great assurance concludes; *Nervi igitur, rivorum in morem, à cerebro, ceu ex quodam fonte, deducunt musculis vires.* Where 'tis remarkable that he compares the Nerves, not to Strings or Cords, but to *rivuletts* or *Conduit-Pipes*, framed for the conveyance of the invigorating influence, or πρώτη ὁρμὴ (as he calls it) first *impetus*, from the Brain, as from a Fountain. And what could he have said, either more intelligible in it self, or more favorable to the doctrine of animal Spirits?

*Fourthly* and lastly, it is not unworthy consideration, that the voluntary Motion [τῶν ἀπόδων] of *Reptils*, such as Earth-Worms, Snails, and such like (whose progression the Greeks call by a most proper Word, ἑλύσπασιν and ἑλύσπωμα; most accurately described by *Aristotle*, *lib. de incessu animal. cap. 9.*) is performed by the help of a certain *aerial* or *spirituose* Substance issuing from their Heads; discernable, in

Snail, by the ſight. For, if you put a large grey Snail into a clear glaſs Phial, and hold him up againſt a good Light; you may plainly perceive, that when he begins to creep, a Chain of little Bubbles will come from his Tail, and move along one after another to the middle of his Back, and thence up to his Head. When the Snail remains quiet, the motion of the Bubles ceaſeth: and as he again begins to advance, they alſo begin their Courſe anew; paſſing, by a kind of ſlow Circulation, from the Tail to the Head, along the Back; and from the Head to the Tail, along the Belly. So that it ſeems probable, that theſe Bubbles being protruded or propelled in the manner deſcribed, are inſtrumental to the Motion of the Snails forepart, to which he after draws up his hinderpart, *arcuatim*, making an Arch in the middle; and ſo advances. *Quia poſtquam priore parte proceſſerit, mox poſteriorem ad illam, ſe convolvendo, trahit; ita ut videatur arcuatim & annulatim progredi*; as the many-tongued *Monſr. Bochart* ſaith, in his diſcription of the Motion of a *Horſe-leech*; in *Hierozoic. lib. 5. cap. 19.* Now, though Nature be obſerved to diverſifie the Inſtruments of voluntary Motion, in various Sorts of living Creatures, according to the diverſity of their Bulks, Shapes, Functions, and neceſſities of Life; and therefore to infer a parity of contrivance of them in more perfect Animals, from an obſervation of the Action of thoſe in leſs perfect, be but an inartificial Argument: yet foraſmuch as ſhe ſeldom varies her more general ways of formation, but upon neceſſity; and when ſhe doth, her deflections from her common Method, are never ſo wide, but ſtill they carry ſome Analogie to them: it ſeems not improbable, that as the progreſſive Motion of Reptils is performed by the help of an Aerial Subſtance, ſo likewiſe our muſcular Motion is made by the help of a ſpirituoſe

Influx

Influx from the Brain into the Nerves and Muſcels.

And this is the ſum of the principal Arguments urged, partly by the Antient, partly by the modern *defenders* of animal Spirits, and of their neceſſary uſe in voluntary Motion.

I will now, according to my promiſe, change my Perſon, and putting on that of an *Opponent*, plead a while againſt both their *Exiſtence*, and their ſuppoſed *uſe*: taking the liberty to allege, what at preſent I remember to have been ſaid by others, and what I humbly conceive may with reaſon be ſaid, to weaken at leaſt, if not wholly ſubvert the former doctrine.

We Phyſicians indeed ſpeak magnifickly of *Spirits Animal*, as of the plenipotent and immediate inſtrument of the Soul in all her operations upon the Body: confidently attributing to them, *veluti Demiurgis quibuſdam*, whatever of deſigned Motions are performed by the Nerves and Muſcles, whatever of natural Motions are performed by the Diaphragm, and Heart, whatever of violent Motions happen in our exorbitant Paſſions, in fine, whatever of commerce or communication there is betwixt the Brain and all inferior Parts, in the ſtate of Nature, as if we aſſented to the Dream of *Heraclitus Epheſius*, πάντα ψυχῶν εἶναι καὶ δαιμόνων πλήρη. *Diog. Laert. in vita.* Yea more, in a *Preternatural* State alſo we make them only not omnipotent. For, what Diſeaſe of the Brain can ye name, which hath not been referred to their Vices, either to their defect, or exceſs; to their ſtupidity and ſluggiſhneſs, or their fury and tumults; to their interception, or too copioſe and impetuoſe Influx; to their fixation, or inceſſant exagitation; to their depravation by exotique and inconvenient Mixtures, to their diſſipation by Opiates and Narcoticks; or to ſome other of a thouſand accidents, to which they are ſuppoſed to be Obnoxious.

Nay,

Nay some have gone yet much farther, and (were it not indecent to divert to Romantic Writings) I could quote an *Author* of no small Fame, who hath not many Years past enrich'd the Commonwealth of Philosophy with a whole Legend of the Empire of Animal Spirits, their Laws and Constitutions politick, their quickness of perception, presagition of Dangers, Passions of Love, Anger, Hate; their Seditions, Tumults, Insurrections, military Rangings, Sallies, Excursions, Combates, Incampings, Marches and Countermarches, Explosions or Fireings, Retreats in order, confused Flights, and infinite other admirable things, such as I, for my part, should not have had Wit enough to ascribe to any but *Reasonable* Creatures. Nor shall I blush to confess, that when I was reading this Fanciful Book, I could not but recall to mind many of the Witty Fictions of *Lucian* (*verar. historiarum Lib.* 1.) concerning the *Militia* and adventures of his *Hippogypi*, *Lachanopteri*, *Cencroboli*, *Scorodomachi*, *Psyllotoxotæ*, *Anemodromi*, *Struthobalani*, *Nubecentauri*, *Aeroculices*, *Solarii*, *Lunarii*, *Nephelococcygians*, and other chimerical Nations by him in Drollery described; and all the pleasant Dreams of a certain great Lady, recounted in her most delightful Histories of the *Blazing World*, and of the *Kingdoms of Fayries* in ever Mans Brain: though I at the same time considered, that *Lucian* and the *Lady* had written only in Jest, to exercise their Wit: but the other, in serious earnest, and with design to reform the State of Physic, by new discoveries. So true is that saying of a late ingenious Writer; *Ubi semel occupatum ingenium est novis Hypothesibus, licet solis innitantur conjecturis; in infinitam conceptuum libertatem se diffundit: ne disputare quidem cum rei veritate amplius sustinet. Tam irrequieto & exultante impetu stimulat in ulteriora voluptas glorioſa.*

And

And yet notwithstanding, after all our specious discourses of these Emissaries of the Soul, Animal Spirits; we are distracted by various Opinions concerning them: still anxiously inquiring, of what *matter*, in what *place*, and *how* they are generated; what are their *Qualities*, *Motions*, *Ways*, and *Manner*, of acting; and in fine, uncertain, whether they be *real Creatures* of Nature, or only the *Idols* of human Imagination. *Risum teneatis amici, an lachrymas? Certè res est haud perfunctoriè lugenda.*

*Some* have affirmed, that the *Fluid* contained in the Pores and Fibres of the Nerves, is the more subtil part of the Blood, separated and sublimed in the Brain; giving it the noble Name of *Spirits*: but they have not yet by certain reasons or Experiments, taught us, to which of all the Fluids that are known to us, that is like. *Others* therefore proceeding somewhat farther, pronounce that these Spirits consist of *Saline* and *Sulphureous* Particles highly analogous to the Spirits of Wine. But this is to feed our curiosity with fine Words that signifie little of certainty. True it is indeed, that upon drinking a little Glass of Spirit of Wine, we find our Strength suddainly recruited: but whether from the Humor we call Spirit, or from that other Matter that makes that Spirit Fluid, or is perhaps for some other reason joyned to it; who hitherto has determined? Besides, the animal Spirits (if any such there be) seem to be so so far remote from the *subtility*, *Acrimony*, and *volatility* of Spirit of Wine; that we want not just reasons to convince us, they are nor volatile, nor actually Rarefied into Exhalations, nor acrimonious. *Not Volatil*; because if they were such, certainly they would offend and trouble the Brain; as may be inferred from the Lassitude, Headach, giddiness and other Symptoms that commonly invade

Men

Men next Morning after a Debauch with Wine; all which come from the volatile Spirits of the Wine. Not *actual Exhalations*; becauſe in that State, being mixt with other Humors of the Body, they would produce Bubles or Froth, or cauſe alſo an inflation of the Parts containing them: neither of which is to be endured. Not *Acrimonious*, pungent, or offenſive by aſperity of their Particles; becauſe if ſuch, they would continually irritate, prick, and corrode the Brain and Nerves, and neceſſarily force them into Convulſions, and other tumultuoſe Motions. I add, that they are not (as *Fr. Sylvius* imagined them to be) apt to *Ferment*; becauſe if ſuch, they could not but fret and diſſolve the ſoft and tender Subſtance of the Brain, and the Pith of the Nerves.

By theſe and other Reaſons induced, our moſt excellent Dr. *Gliſſon* (*de Ventric. and Inteſtin. Cap.* 8. *num.* 7.) formed his animal Spirits of a conſtitution exempt from all theſe inconvenient Qualities. He deſcribes them to be *Mild*, *Placid*, *Sedate*, *Fixt*, *Sweet*, *Nutritive*, *Corroborating*, and apt to *conſolidate*; and in all theſe reſpects exactly like the Spirits conteined in the white of an Egg. Their *Subject* he held to be, the true *Succus Nutritius*, diſtributed from the Brain, through the Nerves, to all ſpermatick Parts: which he would have to be generated only in the Brain (*corticem inter & medullam*) by way of *Secretion*; and that the matter of which they are in that manner generated, is the more *mild* and *ſpermatic* part of the Blood; the *acrimonious* and more elabourated Part being reduced thence by the Veins, for that purpoſe perhaps diſtributed into the *Cortex* of the Brain: concluding, that the ſelect part is changed into animal Spirits, not by ſublimation or meteorization (as all others held before) but by *mitigation*, *refrigeration*, and

and *Whiteniug*. So that in fine, if their Nature agree with this Character; I do not see by what right they can be called *Spirits*, according to the common notion Men have of all things known by that Name.

In so dense a Mist of our understanding, in so great and irreconcilable a dissention of Opinions, concerning the matter, generation, and qualities of animal Spirits; how shall we discern the truth? Whom can ye give me, so sagacious, so happy above all other Mortals, in explicating the Secrets of the Oeconomy of mans Brain; as to be able, by clearly defining what they are, whence they proceed, and how they are generated, to put an end to the Dispute? For, till this be done, we shall still be to seek, how they can conduce to invigorate the Nerves and Muscles in voluntary Motion. In the mean time we can be certain only of this; that so great a War of Opinions among the Princes of Phylosophy, is a strong Argument, that the thing about which they contend, is not yet sufficiently understood.

Equally uncertain it is, by what kind of *Motion* these invisible Emissaries are transmitted from the Brain through the Nerves; whether they fly *swiftly*, or creep along *slowly*. For, some there are, who fond of the Chimera's of their own Imagination, and carried away by affectation of Glory from the invention of I know not what new Theories in Physic, as if Philosophers were, like young Ladies, best pleased with Novels; have confidently taught, that these Spirits are not only moved most rapidly in the Brain and Nerves, as Lightning is darted through the Air; but as it were shot out, at command of the Phantasie, into the Nerves, and recall'd again by the same ways, in an instant, according to the exigence of the Actions to

be performed by them. And yet neither of these seems consonant to right Reason.

Not the *Former*; because in their supposed Motion from without inward, by which these *Gent.* would have all sensation to be made; the perception of a tangible Object (for example) which is made in the top of a Finger, is in the very same Moment perceived within in the Brain: and the Action of the Finger, and the Action of the Brain, make one continued total sensation of the whole Object. Which could never be, in case that Sensation were performed immediately by the Ministry of Animal Spirits. For, these Spirits, so soon as they are informed in the external Organ of Touching, of what nature the Object is; cannot bring in tidings of what is done there unless they recur and fly in to give an account of their Embassy, and at the same time desert the outward Organ: So that the action of the outward Organ cannot be *coincident* with the action of the Brain: unless you can obtain of them, that the very same animal Spirits are in the Finger, and in the Brain, at the same time; which is manifestly absur'd. Evident therefore it is, that Sensation cannot be made by the mediation of animal Spirits, as these Positive Wits have defined.

Not the *Later*; because we do not find, that Nature hath any where in the Body instituted contrary Motions of the same *Fluid* in the same Vessels; unless in the branches of the Wind-pipe, and in the Guts. In *respiration*, the Air is both received into the Lungs, and thence quickly emitted, together with the Vapors of the Blood, by the *aspera arteria:* which being to that end made of round or circular Gristles, is alwaies open; and the *Thorax* is always organically dilated and contracted alternately. In the *Gutts* also

alſo Nature hath ordained a Flux and reflux of the Chyle; but they have a *Periſtaltic* motion granted to them, to that end, in order to the frequent inverſion, and more expedite diſtribution of the Chyle. But in the *Nerves* there occurs no ſufficient reaſon, why the Spirits ſhould be carried ſometimes outward, and ſometimes inward; unleſs we attribute to them a Periſtaltick motion, or imagine that the Spirits themſelves, like Gnats playing in the Air, fly to and fro in the Nerves, at their own pleaſure. Farther, to what end ſhould they *recur* to the Brain through the Nerves? To relate to the commmon Senſe what is done in the external Organs? If ſo, with what Tongue can they deliver their relation? By what ſigns can they give notice of their meaning? Do they bring in with them the *idea* of the impreſſion made by the Object upon the external Organ? Certainly, the *idea* in the outward and inward Organ, is one continuate repreſentation, as the Object repreſented is one. But the ſenſation of the ſame Object doth ſometimes dure two or three Hours together. Do the Animal Spirits all that while run forth and back unceſſantly, to continue the ſenſation both without and within? Theſe truly are to me inextricable difficulties, Riddles never to be expounded, or rather extravagant fictions, ſuch as might diſſolve even *Heraclitus* himſelf into laughter.

No wonder then if *Dr. Gliſſon*, plainly diſcerning the incongruity of this moſt rapid and reciprocal motion attributed to the animal Spirits, not only wholly rejected it, but excogitated another plainly *contrary* thereunto. For, he concludes, that the Spirits lodged in the *Succus Nutritius*, are carried from the Brain through the Nerves by a Motion, not impetuoſe or rapid, but *gentle*, *Slow*, and *placid*, inperceptible by

the Senſe, and tending only *outward*; as the nouriſhing Juice of Plants is believed to creep up from the Roots along by their Fibres: and that they do not immediately move the Muſcles, but by recruiting their Vigor, and corroborating the tone of their Fibres, render them habil to execute their Offices promptly and ſtrongly. He adds, that in all voluntary Motion, the Fibres of the Muſcles do, by their own proper vital Motion, abbreviate or contract themſelves; needing no copioſe aud ſuddain afflux of Spirits, either Animal or Vital, to ſhorten them by way of *inflation*, and put them upon performing the Motions commanded by the Phanſie.

How then are the votes or mandates of the Ruling Faculty in the Brain, communicated and made known to the Fibres of the Muſcles deſtined to put them in execution?

He *anſwers*, that the motion of the Brain from *within outward*, by which it rules the Fibres of the Muſcles, is made known to the Fibres to be moved, not by ſenſe (for the *Intellect* hath no notice or cognizance of it at all) but only by *Natural perception*: and conſequently that the Brain, by mediation of this Perception Natural, doth, at command of the Phanſie, excite the Fibres of the Muſcles to Motion, and recompoſe them, at pleaſure. And to explain more clearly his ſentiments concerning this ſuppoſed motion of the Brain *ad extrà*, that is, to the originals of the Nerves, which he ſeems firſt to have excogitated: he ſoon after ſubjoyns, that the Motion is not to be underſtood of the whole Brain, but only of that little part of it, the Fibres of which are conjoyned to the Fibres of the Nerve peculiarly deſigned to perform the action commanded by the Phanſie; and that this Motion is no other but a certain *Striate* or Streakt invigoration, running along the

the Threads of the Brain, toward the beginning of the Nerve to be excited, and requiring a Motion of the Nerve conform thereunto: By invigoration, meaning a Motion tending to a greater contraction of the part of the Brain then acting, than before. *Contractio enim hic requisita* (saith he) *fortasse ducentesimam partem crassitiei digiti transversi non superat; nec refert, quàm exigua sit mutatio situs, modò tensura sit nervo perceptibilis, & gradibus variari possit, prout appetitus fortiorem aut debiliorem actionem à nervis exigit.* An Hypothesis (I must confess) most subtle, and worthy the sublime Wit of the Author, and perhaps coming neerer to Truth, than any other hitherto excogitated.

And yet notwithstanding, had not fate, by taking the Author from us, prevented me; I should ere this have taken the liberty to beg his pardon of my foolishness, if out of an honest desire of learning from him, I presumed to trouble him with one or two Questions about things delivered in this Hypothesis, which to me seem doubtful, and extremely difficult to be conceived.

The *first* is this. He supposes the Brain, not only to have power of moving itself at pleasure, but (what is yet more amusing) to be also the principle of our cogitations, of our Appetite and Motion Animal: which I cannot (such is my dulness) comprehend. For, though it be granted, that the medullary substance of the Brain, however soft and tender to the touch, may nevertheless, in respect of the small Fibres of which placed in streaks it is composed, be capable of some Tension and Remission: yet do I not see, by what reason it can, either think, desire, or move itself at pleasure, in order to voluntary Motion. Hitherto I have been so great a Bigot in the catholick Doctrine of Philosophers, as to believe the *Brain*

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to be merely an Organ of the Soul (whether Rational, or Senſitive) and govern'd, and invigorated to motion by the Mandates thereof, not by it ſelf alone: and that it is of the Nature of every Organ, as an Organ, not to give Motion to it ſelf, as abſolute and independent, but to receive Motion from that, whoſe Organ it is; never ſo much as dreaming, that the Brain itſelf hath the Faculties of *thinking* and *deſiring*, which I always took to belong of right to the Soul alone. "But now I hear one of the Princes of "Anatomiſts expreſly teaching the *contrary*, *viz.* *Ce-* "*rebrum per ſe percipere, &, quia ſic percipit hoc vel* "*illud objectum eſſe bonum vel malum, etiam appetere* "*hoc fugere, illo frui; & quia ſic appetit, mox ſe mo-* "*vere, ut quod appetit, conſequatur:* and yet am not able to diſcern, how this new Doctrine can poſſibly be brought to conſiſt with that antient and univerſally granted *Axiom* Phyſical; *nihil corporeum à ſeipſo moveri, ſed ubiq; in univerſitate rerum dari movens & mobile inter ſe quidem diſtincta; ita tamen, ut movens & mobile ſint ſimul, motúſq; hoc modo ſit compoſitum quid ex utroq;.*

Ye will here tell me, I preſume; that my moſt ſagacious Author ſpeaks in this place, not of Animal, but *Natural* Perception, Appetite and Motion; which three Faculties he aſſerts to be by ſo firm a confederation colligued, as to be inſeparable, and to render their Subject ſufficiently inſtructed to perform every work congruous to its Nature.

I ſay therefore; that although we ſhould grant to the Brain this ſuppoſed *Natural Perception*, with its inſeparable adjuncts; yet this would by no means ſuffice to excite and cauſe *Animal* or Voluntary Motion, firſt in the Fibrills of the Brain, then in the Nerves, and after in the Muſcles: becauſe this Motion

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is far *nobler* than any Motion meerly ſpontaneous, and proceeds from, and depends upon a principle incomparably more ſublime and energetic; namely the *Soul*, which (if all Mankind be not moſt groſly deceived,) is Author of all Motion directed by Counſel and deſign to this or that certain end; and which is always excited by the appearance of Good or Evil in the Object, when an Animal deſires what is convenient, or flyes the contrary, and accordingly moves to obtain, or eſchew it. Otherwiſe, or I am ſhamefully ſottiſh, or no living Creature would need a Soul to excite him to intend and perform Motions convenient to his nature and end: Becauſe the Brain it ſelf, endowed with natural Perception and its Concomitants, would alone ſerve to do all the Offices of a ſenſitive Soul. And this is one of the two doubts, that hath hitherto perplext my weak Head, and with-held me from aſſenting to this new Hypotheſis: chiefly when I recall'd to mind, that a Chicken begins to move himſelf in the Egg on the ſixth day of the incubation; though at that time nothing of Brain, beſides clear Water included *in veſiculâ*, can be diſcerned.

The *other*, this; *How ſo ſmall a contraction of the Fibrils of the Brain, in that part which is moved by the Appetite, as He ſuppoſes not to exceed the* 200*th. part of a Fingers bredth, can ſuffice to make a much greater Contraction in the Nerve deſtined to perform the action commanded.* For, ſince the Fibrils of the Brain are not only conjoyned with the Fibres of the Nerves thence produced along to the Tendons of the Muſcles, but ſo united alſo, as to conſtitute ſo many little Strings or Cords continued from their Original to their ends or inſertions; and ſince it is from mechanic experiments conſtant, that all Cords, when pull'd or ſtretch'd at one end more or leſs, are equal-

ly,

ly extended all along quite home to the other; and this is by reason of the continuity of their Parts: considering these two certain and evident Truths, I cannot conceive, how in the said little Cords of the Brain and Nerves any Contraction or Tension can be made, that shall be in one of their Extremes, at least two hundred times less than in the other. It is indeed, among *Physico-mathematicians*, a mighty controversie, whether or no the Strings of a Lute, Viol, Harp or any other musical Instrument, when wound up, be equally stretch'd or strain'd in all their Parts; because when they are strain'd above their strength, they are for the most part broken at the ends, rarely in any other part: which yet seems to happen only from hence, that the Strings are at both ends weakned by winding up the Peggs, and being tyed in a knot, whereby their coherence of Parts being violated, they must needs be more fragil there, than in any other part to which that Violence hath not extended. Nevertheless, that a Lute-String stretcht by a Plummet hung perpendicularly at one end, and held by a Mans Fingers at the other, is extended in all parts alike; is beyond all controversie. And that is sufficient to my purpose. For from thence it is most evident, that howsoever, and in what part soever a Nerve is contracted, the contraction must be equal in all Parts of it: not only a Hairs bredth at one end, and two or three Inches perhaps at the other.

But perhaps the Sense of my most judicious Author is this. That even the least vigoration of the Brain (which he supposed to be the principal part of the whole Animal, the original of Cogitation, Appetite and Motion, composed of Fibrills, and endowed with a faculty of stretching and relaxing itself by turns, at

at pleaſure) may ſuffice to excite a much greater contraction in the Nerves; not ſo much by immediately contracting them, as by ſo affecting their perception natural, as they may preſently contract themſelves by ſpontaneous Motion, and that ſo much as is ſufficient to execute ſtrenuouſly the command of the Phanſy.

Admitting therefore this interpretation of his words, I enquire, if that Δύναμις θερμαντικὴ, or invigorating Virtue which he confers upon the Brain, conſiſt only in the tonic Motion of its Fibrils, to which the Fibres of the Nerves are continued; if this be ſo, I enquire (I ſay) firſt, *whence it is, that a greater and ſtronger Force or Vigoration is excited in the Threads of the Nerves, than in the Fibrils of the Brain that move them*? Is the *Spontaneous* Motion of the Nerves, (always conjoyned with natural perception) more potent than the *animal* Motion of the Fibrils of the Brain, injoyned or commanded by the Will, or Phanſie? ſo, certainly, it muſt be granted to be by all who embrace this Hypotheſis; becauſe a far greater Contraction is ſuppoſed to be made by the natural or ſpontaneous Motion, than by the animal or commanded Motion: and becauſe it is of abſolute neceſſity, that this diſparity of the Effects ariſes from the like diſparity in the Powers of the Agents. But to me (I confeſs) it ſeems alien from all belief, that Nature, whoſe Wiſdom and Providence is ſo admirable in all things elſe, hath taken ſo little care of the Oeconomy of Mans Brain, as to ſubject the principal Inſtruments of voluntary Motion, the Nerves, more to the ſimple inſtinct of natural perception, than to the Empire and rule of the Will conceived from the dictates of Reaſon: chiefly when it is moſt evident, that the ſame Nature has granted to us a power of varying, intending, and remitting our voluntary Motion, as

we pleaſe; without control or impediment from the inſtinct of natural perception, of which we are not conſcious. I inquire alſo, *whether the ſo often mentioned Fibrils of the Brain have requiſite Notice, both of the command given by the Phanſy, and that it is their Office to put the ſame in execution?* My Author expreſly affirms, they have: deducing the knowledge of *this* from their natural perception, and the notice of *that*, from their Tenſion by the Phanſy. His Words are theſe; *Cum hæ fibræ tenſiles ſint, & naturali perceptione advertant, exſecutionem voti cupiti ad ſuum officium ſpectare; mox (cùm ſimul ſint agentia naturalia, nec deliberent) ſe vigorant, & nervos, quibus continuantur, ad conſimilem motum excitant. Naturalis enim perceptio (ſeu Archeus) innumera propè novit, quæ ſenſum latent; & totam fabricam corporis, quam ipſa formaverat, & uſum omnium partium, modumq; quo omnia peragenda ſint, callet.* But if this be granted, certainly either the Phanſie muſt be deprived of its dominion over the Fibres of the Brain, or (what ſeems to be no leſs unjuſt) there will be ſet up in the Brain a new Government by a kind of *Duumvirate*, the Regimen being divided betwixt the *Will* and *natural* Perception, ſo that neither of them can, without the aſſent of the other, excite any the leaſt animal Motion. And how unſtable, how obnoxious to Diviſions muſt that State be, that hath two Heads?

Other Knots there are in this moſt intricate Hypotheſis, which my weak Reaſon is not able to untie. But I pretermit them; thoſe two I have touched, ſeeming ſufficient to evince, how little, how uncertain that knowledge is, which even the greateſt Wits have attained unto, of the regiment of the Brain, of the Motion of animal Spirits, and of the reaſon of voluntary Motion.

Perhaps

Perhaps then we are equally uncertain, whether there be *in rerum natura* any such things as animal Spirits, of a distinct Species from the vital Spirits, or not. Truely, my Opinion is, that we are so: and no less Man than *Dr. Harvy* expresly denyed their *Existence*; *de generat. animal. exercit.* 70. *Nihil sanè in corpore animalium, (inquit) sanguine prius aut præstantius reperitur; neq; spiritus, quos à sanguine distinguunt, uspiam ab illo separati inveniuntur.* So do all the *Peripatetiques* hold againſt *Galen*, *unum esse duntaxat Spiritum, vitalem singulis partium omnium officiis deservientem.* Joan. Imperial.de ingen. human. pag. 52. *And* Scaliger (exercit. 339. Sect. 2.) affirms, *Animam non egere spiritibus ad motum. Etenim si animæ opus est instrumento ad movendum; etiam opus erit instrumento ad movendum instrumentum.* And Sr. G. Ent (Antidiatribæ p. 141.) *Ego, præter unum sanguinis* calorem, *nullos in animali* Spiritus *agnosco: sed in partibus singulis privum hospitari sensum, qui ad animæ imperium excitetur.* So doth that most excellent Man here present, to whose incomparable Pen *Dr. Harvey* ows half his Glory, and to whose diving Wit both Natural Philosophy and Anatomy owe the hints at least of the best part of their new Discoveries. And truly if any man shall seriously, and without prejudice consider the great bulk, cold temperament, various parts, fabrick and texture of the Brain; he will at length find but little reason to believe, that Nature hath framed it chiefly for a Laboratory of Spirits. They tell us, that these spirits are made of the most subtile, most refined, and volatilized parts of the arterious blood, by way of *sublimation.* But can a part so dense, so cold, so clammy, and to like a bogg, as the brain seems to be, be thought an instrument fit for sublimation or rectification of a spirituose substance? What

Chymiſt hath at any time attempted to rectifie ſpirit of wine in a veſſel whoſe head was ſtuffed with damp raw ſilk, or other the like villoſe matter, more apt to repercuſs and condenſe, than to refine it? Sure I am, that even *Malpighius* himſelf, a moſt accurate Enquirer into the ſtructure of the brain, hath after all his Microſcopic reſearches, made this ingenuous confeſſion "*(de ſtructura viſcerum, pag. 66.) Ut verum fatear,* "*quò magis manifeſta mihi eluceſcit cerebri ſtructura, eò ma-*"*gis tot mirabilium operationum explicandi methodum* "*ſpes excidit. Simplicem tandem dum agnoſco cerebri ſtructu-*"*ram, ineptum omnino ad exponenda ſenſuum, & tam no-*"*bilium operationum phœnomena reor. Ita ut hoc tantùm* "*conjicere poſſim, à Cerebri & Cerebelli glandulis in con-*"*tinuatos nervos ſeparari ſuccum quendam, ſicut in cæteris* "*glandulis proprio vaſe Excretorio ditatis &c.* A poor account of ſo long and diligent a ſcrutiny! and yet would I could ſee the man that is able to give a better.

Were it not a *Parergon*, I might here recount many obſervations, recorded by Eminent writers, of men, who retain'd the uſe of all their Senſes, imagination, memory, reaſon, and voluntary motion, even to the laſt minute of life; and yet notwithſtanding, in their heads opened after death, there was found (as in moſt fiſhes) but very little of brains, and that too altogether confuſed and diluted with water. For a memorable Example of this kind, give me leave to put you in mind of that regiſter'd by *Nichol. Tulpius*, an Author of good credit (*obſervat. Medicar. lib.* 1. *cap.* 24.) Who thereupon gravely concludes with this Laudable acknowledgment of his ignorance. *Quantum eſt, quod neſcimus! velut nanq; in aliis, ſic certè credibile eſt, potiſſimùm nos cæcutire in genuino Cerebri regimine: Cujus opera multo fortaſſis ſunt diviniora, quam quiſpiam hactenus ſuo comprehendit captu.* Ye may add

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two other Examples no leſs wonderfull: one obſerv'd by *Gregor. Horſtius*, of a man who after a great abſceſs or apoſteme in the head, and the taking away of a vaſt quantity of his brain, yet retain'd the uſe of all the Animal faculties: the other, by *Kerckringius* (*obſervat. anatomic.* 46.) of an infant, whoſe skull he had found full of a mucoſe water, in the place of the brain. Hither may be brought two other examples: one from *Fontanus* (*reſp. med. & annot. in Veſal.*) of a boy, *cui caput erat cerebro vacuum*; another from *Arnoldus Villanovanus* (*in Spec. intr. med.*) of a man whoſe skull was found likewiſe empty. Now if theſe be true Hiſtories, what will become of the ſuppoſition, that the Animal ſpirits are generated in the brain? Can they be made, and conſerved in water, and after moſt part of the brain hath been taken away? Here I am at a ſtand; wanting the wit of *Thom. Bartholin.* Who (*in obſervat. centur. 6. Hiſt. 91.*) having told a very ſtrange ſtory of a Swediſh Ox, whoſe brain was wholly converted into a ſtone; and deſirous ſtill to prop up the antique opinion of Animal ſpirits, which that obſervation impugned: was firſt ſo ingenuous as to ſuſpect, and after ſo lucky as to find certain holes and open paſſages reſerved for them in the petrified brain, through which they might freely paſs into the nerves to carry the heavy headed beaſt to and fro in the meadows for paſture. A wonderful providence of Nature this, to continue both the poor Animal in motion, and the doctrine of the ſpirits in reputation. And therefore leſt ye ſhould think I do the learned Author wrong, I am obliged to recite his very words in the clauſe of the Hiſtory. *Quum prima ad nos fama rem novam & hactenus inauditam deferret, dubitare cæpi, & hinc inde cogitationes volvere, quomodo integer bovi remanſerit motus ad horam uſq; à lanione indictam,* lib. de morb. contagioſis par. 2.

"*dictam, cerebro lapideo; suspicabarq; in vivi bovis*
"*cerebro indurato sinus patulos remansisse, per quos liberè*
"*spiritus animales ex arteriis nervisq; commearent; a-*
"*liòqui bovi omnis fuisset motus dudum ademptus. Nec*
"*vana fuit conjectura. Testabatur enim mihi Illustris*
"*Bielkius, foraminula hinc inde in lapide nominato con-*
"*spici dispersa & perforata, per quæ paleæ possint intrudi.*
Here to question the truth of his relation, would be *Incivility*; to believe all parts of it, shameful *credulity*; and to conclude from thence, that there are Animal spirits, down right *folly*: the Author having omitted to bring any good *reason* to support his conjecture, that the holes observed in the petrified Brain, had been left for no other cause, but only to give free passage to them. I add, that in the head of the *Rana piscatrix* which yet is a fish of singular cunning in taking his prey, and of great strenght, no Brain, but only clear water, is to be found.

To come then to a conclusion of this desperate Argument; from what hath been said, it sufficiently appears, that we are still in great uncertainty, not only of the *matter*, *generation*, *Nature*, *qualities*, and *motion* of Spirits Animal; but of their very *existence* also. I had reason therefore to appeal to your more discerning judgment, for a decision of this so difficult controversie concerning them: being my self unable to determine what I ought to conclude, of the Antient, and at this day vulgar opinion, of their being absolutely requisite, both to all sensation, and to all voluntary motion ¶

Nor do I blush to acknowledge this my ignorance of a thing which Nature seems to have wrapt up in clouds of impenetrable darkness, *ne veritatis Inaccessibilis lux teneram ingenii humani aciem splendore nimio*

*nimio perſtringeret* : But frankly confeſs with *Lucretius*;

*Multa tegit ſacro involucro Natura neq; ullis*
*Fas eſt ſcire quidem mortalibus omnia. Multa*
*Admirare modò, nec non venerare: neq; illa*
*Inquires, quæ ſunt arcanis proxima. Namq;*
*In manibus quæ ſunt, hæc nos vix ſcire putandum eſt;*
*Eſt procul à nobis adeo præſentia veri.*

"And enquire with *Caſper Barlæus* (*de anim. Hu-*
"*man. admirandis*) *Qua ratione, et quibus apparitoribus*
"*mandata mentis deferri poſſint momento ad membra*
"*remotiſſima*? *cùm nec membra hæc, nec ſpiritus inter-*
"*nuncii, aut mandata capiant aut mandantem norint. Volo*
"*Currere pedes*? *currunt: quieſcere*? *quieſcunt. &c. Quin*
"*illud omni ſapientiâ humana majus eſt, quomodo pul-*
"*ſantes citheram digiti, pari motu celerimas cogitationes*
"*aſſequantur; ut nec a mente digitus, nec a digito mens*
"*relinquatur.*

But this my ignorance muſt not deter me from proceeding in the adminiſtration of my province. I come therefore to the *inſtrumentum proximum ſive ultimum*, by which immediately and ſenſibly the act of voluntary motion is performed. This all men rightly hold to be the *MUSCLES*: in which there occur three Generals to be chiefly conſidered by the Anatomiſt; viz. their common *Conſtitution* and ſtructure; their principal and ſenſible *Differences*; and the *Reaſon* by which they move the parts to which they are affixt. For, theſe things being duely explain'd, may perhaps bring us at length to ſuch a degree of knowledge of the manner of voluntary motion, as may, if not ſatisfie our Curioſity yet at leaſt advance the nobleſt of all our intellectual delights, the grateful admiration of

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the infinite Wisdom of our *Creator*. Which as it is the principal End of our *Being*: so ought it to be also the grand scope of all our *studies* and *Natural inquiries*.

Concerning the *FIRST*, therefore; obvious it is to every mans reason, that the immediate organ of voluntary Motion ought to be of such a *Constitution*, as may render it apt both to receive invigoration, i. e. to be excited to motion, by the Brain, at the command of the will, appetite, or fancy: and to move the member or part to which it is affixt. Manifest therefore it is, that a hard inflexible, rigid and bony substance is so far incompetent to both those uses, that *Galen* (*de motu musculor. lib.*1.*cap.* 2 ) affirmed, that any part casually becoming hard and stiff, though only from a thick cicatrice or skar, is thereby rendred unfit for motion: and that consequently, the substance of a Muscle ought to be, as Nature has made it, *soft*, *rare*, *flexible*, *extensible*, and furnished with great store of *fibres*.

Requisite it is also, in respect of the distance betwixt the Brain and the Muscle, that there should be some third thing intermediate and continued to both, by which the πρώτη ὁρμὴ, or first impetus in the former, may be communicated [ κατὰ τὸ συνεχὲς ] to the other, whether the invigoration be effected by influx of any substance from the Brain, or by *Dr. Glissons* way formerly described. And the *Nerves* being the only part of the whole body qualified for this use, Nature hath therefore most prudently inserted one, or more of them into each Muscle. Now these two parts, *Flesh* and *Nerves*, are the principal ingredients requisite to compleat the essence of a Muscle: as may be inferr'd from hence, that there are some perfect Muscles, particularly those of the Forehead, the Temples, Bladder, the fundament &c. In the composition of which

which neither Tendon, nor Ligament is to be found.

But becauſe there is in ſome parts to be moved, by reaſon of their greater Gravity, a greater reſiſtance to Motion, than the muſculous Fleſh, in reſpect of its ſoftneſs and tenderneſs, is of itſelf able to overcome, chiefly in ſome poſitions: therefore ought there to be an addition of ſome ſtronger and tougher Subſtance, which being connected or united to the Fleſh of the Muſcle, may both corroborate the ſame, and more firmly conjoyn it to the Bones, ſo as to inable it to overpower that reſiſtance. Hence it is, that ſome Muſcles, eſpecially ſuch as are deſtined to bear great ſtreſs, in ſurmounting the weight of great Members, or in ſtrong Motions; are furniſhed with *Ligaments*, as well for their better firmation to the Bones, as for augmentation of their ſtrength. All which *Galen* (*de uſu partium lib.* 12. *cap.* 2. *& de motu muſcul. lib.* 1. *cap.* 2.) "intimates in theſe few words; *Vinculo enim tuto quodam opus erat muſculis, cum oſſe ab ipſis movendo; nec erat aliud ad hoc aptius Ligamento.*

But this neceſſity not extending to all Muſcles, and a ligament being of it ſelf immoveable and inſenſible, and the Nerves being, in reſpect of the ſoftneſs and laxity of their Subſtance, not ſufficiently ſtrong to pull great and heavy Bones, without ſome acceſſion of ſtrength: it was requiſite, there ſhould be of both thoſe parts compoſed a *Third*, that might be firmer and ſtronger than a Nerve, but ſofter and weaker than a Ligament. Such is a *Tendon*, which in Senſe, and Aptitude to Motion much exceed's a ligament; and in ſtrength a Nerve: and is therefore made a part of many Muſcles. I ſay, of many Muſcles, not of all: becauſe ſome have no need of Tendons, as the Muſcles of the *Tongue*, of the *Teſticles*, of the *Penis*, *Lipps*, *Forehead*, and all *Sphincters*; but thoſe only that are

framed for Motions either ſtrong or continual. Thoſe that were deſtined to the motion of Bones, do all end in Tendons, greater or leſs; and are inſerted, not into the Syntax or conjunction of two Bones, nor into the end of the ſame Bone from which they ariſe; but near to the Head of another which they are to move. Thoſe which are to be kept long in Motion, have likewiſe need of Tendons both to corroborate and facilitate their Motions: as is moſt evident in the Muſcles of the *Eye*, all which are furniſhed with Tendons. Hence we come to underſtand, why Tendons are by Nature conferr'd upon all Muſcles deſigned to perform ſtrong Motions in Flexion, in extenſion, and in that which holding a part in a ſtiff and ſteady Poſture, is termed *Motus Tonicus*: as in the Arms and Leggs, and in the Back for erection of the Spine, *&c.* and why other Muſcles are made up without Tendons, being as in their Originals, ſo likewiſe in their ends, only *Fibroſe*.

That theſe four parts of a Muſcle, namely Fleſh, Nerve, Ligament, and Tendon, might not want either Covering, or Combination; Nature has providently inveſted and bound them together with a proper *Membrane* or Coat: which ſeems to have theſe two farther Uſes; to cauſe Muſcles touching or incumbent upon each other, to ſlip up and down ſmoothly, eaſily, and without interfering; and to unite the force of all the Fibres when they act.

And finally, becauſe the whole Organ requires to be continually ſupplied with Life, as *being Pars Corporis Vivens*; therefore is it copiouſly furniſhed with *Arteries* and *Veins*: thoſe to bring in Blood, by whoſe vital Heat all parts are impregnated with influent Life; theſe, to return the ſame Blood to the Heart, after it hath performed that Office. And this may be

be ſufficient to explain the Conſtitution of a Muſcle: upon which if we reflect, we may conveniently enough define a Muſcle to be; an *organical part of an Animal, participant of Life, compoſed (always) of Fleſh and a Nerve, and* (many times alſo) *of a Tendon and Ligament; covered with its proper Membrane; and ſo framed to be the proxime inſtrument of voluntary Motion.* ¶:

As for the *SECOND* general to be conſidered, namely the *DIFFERENCES* obſerved among various Muſcles; theſe are many, as being deſumed from their diverſity in *Subſtance, Quantity, Figure, Poſition, Origination, Inſertion, Parts, Actions* and *Uſes:* all which I will run over lightly.

In reſpect of *Subſtance*; ſome Muſcles are moſtly *Carnoſe*, as all the *Sphincters*, the Muſcles of the Tongue, *&c.* others, moſtly *nervoſe* or *membraneous*, as the *faſcia lata*, abducing the *Tibia*, the *Quadratus*, call'd by *Galen* πλάτυσμα μυώδες, *muſculoſa expanſio*, by others, *Diſtortor oris*, becauſe it is firſt contracted involuntarily in that Convulſion named *Spaſmus Cynicus*; and ſome others.

In reſpect of *Quantity* (which comprehends all the three dimenſions of Longitude, Latitude, and Profundity) ſome are *Long*, as the *Rectus abdominis*, the *Longiſſimus dorſi*, the *Sartorius* in the Thigh, *&c.* Others, *ſhort*, as the *Pyramidales* in the bottom of the Belly, Surrogates of the oblique aſcendent Muſcles, and by a peculiar right conducing to compreſſion of the Bladder of Urine, when we make Water: Others, *broad*; as the *Oblique* and *Tranſverſe* Muſcles of the *Abdomen*, the *Latiſſimus dorſi*, depreſſing the Arm, *&c.* Others, *narrow*, as thoſe of the Fingers and Toes: Others, *thick* and bulky; as the two *Vaſti* of the Thigh, the *Glutei* of the Buttocks, *&c.* Others, *thin* and

ſlender, as the *Gracilis* bending the Legg, *&c.*

In reſpect of *Figure*, ſome are *Triangular*, ſome *Square*, ſome *Pentagonal*, ſome *Pyramidal*, ſome *Round*, ſome of other Shapes; as is exemplified in the *Deltoides*, *Rhomboides*, *Scalenus*, *Trapezius*, *&c.*

In reſpect of the *Poſition* or courſe of their Fibres, ſome are *Oblique*, ſome *Tranſverſe*, ſome *above*, ſome *below*, ſome *before*, ſome *behind*, ſome on the *Right*, others on the *Left* Side. Where we may obſerve in the general, that all *oblique* Muſcles ſerve to oblique Motions, all *Right*, to direct flection or extenſion; all *internal*, to flection; all *External*, to extention.

In reſpect of their *Origination*, ſome ariſe from *Bones*; and that either from the *Heads* of them, as moſt of the greater Muſcles do; or a little below, or from ſome *Glene*, ſome *Sinus* or ſmall cavity in the Bone: ſome only from *one* Bone, ſome from *two* or *three*: others from *Cartilages* or Griſtles, as the Muſcles proper to the *Larynx*: others from the *Membrane* inſhrouding the Tendons, as the *Muſculi Vermiculares ſive Lumbricales* in the Hands and Feet: and others again from other Parts, as the *Sphincters*.

In reſpect of their *Inſertion*, ſome are inſerted into *Bones*, ſome into *Cartilages*, as the Muſcles of the Eyelids, and of the Larynx; others into a *Membrane*, as the Muſcles moving the Eye; others into the *Skin*, as thoſe of the Lips: ſome ariſing from divers parts are inſerted into *one*; and on the contrary, others ſingle in their Original, are divided in their terminations.

In reſpect of their *Parts* (by which we are now to underſtand, not only the Parts conſtituent already particularly deſcribed, but thoſe alſo into which a Muſcle is commonly divided in diſſection, *viz.* the Beginning or *Head*, the Middle or *Belly*, and the Tail

Tail or *Tendon.*) The differences are various: moſt Muſcles have but one head, yet ſome have two, ſome three; whence they are named *Bicipites* and *Tricipites*. Moſt have but one *Venter*, yet ſome are double bellied, as the Muſcle ſhutting the lower Jaw, that of the *Os Hyoides*, whence they are called *Digaſtrici* and *Biventres*: Of ſome the *Tails* are broad and membranoſe, of others round and ſlender; of ſome ſhort, of others long; of ſome perforate, of others entire; of ſome ſingle, of others double, triple, *&c.* In ſome places are found two, three, or more Muſcles ending in one common *Tendon*, as the *Gemelli* in the Leg, and the *Soleus* are united into one Cord above the heel: In others, though contiguous, ſingle and diſtinct Tendons; as the *Plantaris*, though concealed betwixt the *Gemelli* and the *Soleus*, from a fleſhy beginning dwindles into a long Tendon, that ſpreading it ſelf again covers the whole plant of the Foot, and is inſerted into the Roots of the Toes. Laſtly, ſome borrow their Names from the parts upon which they are ſeated, as the *Crotaphitæ* or Temporal Muſcles, the *Rachitæ* or *Spinati* of the Spine, the *Iliaci*, *&c.*

In fine, in reſpect of the diverſity of their *Actions*, the Muſcles admit of a triple difference. The firſt this, that ſome are *Confederates*, both concurring to one and the ſame motion either of Flection or of Extenſion; one being placed on the Right the other on the Left of the Member: Others Antagoniſts, which perform motions contrary each to the other; and indeed there are but few Muſcles that have not their Opponents; to every *flexor* is oppoſed an *extenſor*, to every *adductor* an *abductor*, to every *Elevator* a *Depreſſor*; excepting only the *Sphincters*, the *Cremaſters*, and the *Oeſophagus*. The *Confederates* generally are equal in magnitude, number, and ſtrength; the Antagoniſts not, but different according

cording to the weight of the part to be moved, and to the force of the motion. Thus the Muſcles that bow down the head are but two; when there are twelve to lift it up: Likewiſe thoſe that pull up the lower Jaw are many, but no more than two ſuffice to draw it down, becauſe the weight of heavy parts makes them eaſily fall down of their own accord. The *ſecond* difference conſiſteth in this, that ſome of the Muſcles move only themſelves as the Sphincters, others move *other parts* beſides themſelves. The *third* and laſt difference ariſes from their proper motions; whence ſome are named *Flexores*, others *Extenſores*; ſome *Elevatores*, others *Depreſſores*; ſome *Adductores*, others *Abductores*; ſome *Rotatores*, ſome *Maſſeteres*, ſome *Cremaſteres* or *Suſpenſores*, ſome *Conſtrictores*, *&c.* And this is more than enough concerning the *differences* of the Muſcles. ¶

As for the *laſt* general Theorem, namely the *REASON* and *MANNER* of the Muſcles moving the parts to which they are affixt, when themſelves are invigorate by the Will or Appetite; foraſmuch as the *loco-motion* of the whole body or any part thereof, if conſidered *per ſe*, *i. e.* merely as motion; muſt be conſidered either as it is a certain Commenſuration of the length of ſpace, betwixt the *terminus à quo* and the *terminus ad quem*; or as it is a countervailing of *Gravity*: In both theſe reſpects it requires to be explained by the help of Principles *Mathematick*. Let me therefore deprecate your impatience, if in compliance with this neceſſity, I now and then bring you to reflect occaſionally upon a few *Geometrical* Propoſitions of *Euclid* and *mechanick* fundamentals; ſuch from whence we may borrow ſome beams of light to leſſen, if not wholly overcome the obſcurity of our ſubject.

In the *Firſt* place then, I obſerve: That every Muſcle hath

hath a double motion, the one *Natural*, in which the Fibres ſpontaneouſly retracting themſelves, return to their native Poſition, after the ceſſation of that force that extended them; as all other *Tenſil* Bodies do by the motion of Reſtitution: The other *Animal*, in which the ſame Fibres are farther contracted or abbreviated by a force communicated to them from the brain, in order to the performance of ſome Action intended by the Will or Appetite.

Now that the *Natural* Contraction of a Muſcle is not ſufficient to motion voluntary, though we ſhould ſuppoſe it to have been at firſt made upon the ſtretch, is evident from hence, that betwixt every Muſcle and its Antagoniſt, the natural power of retracting or relaxing themſelves is equal, according to that remarkable Aſſertion of *Galen*, (*de motu muſculor*, *lib.* 1. *cap.* 9.) *Muſculum ſuapte natura in extremam contractionem progredi, quantum in ſtructura corporis eſt poſitum. Cum enim per ſectionem ſolutus fuerit continuitate, quam habet cum oſſe obnitente, tunc quaſi vinculo ſolutus, & perfectè liber factus, ſuam ipſius naturam oſtendit: Quamdiu verò à Muſculo in oppoſito conſtituto pars retrahitur, qui & ipſe eandem naturam habet, ut ſtatim ad extremam contractionem feſtinet, alter Muſculus ab altero æqualiter privatur coitu in ſeipſum. Atque ita contingit oppoſitorum in membris muſculorum utrumque in dimidio contractionis lædi.* So that betwixt two contrary powers drawing equally, the Member muſt remain *tanquam in æquilibrio*, unmoved. The *Reaſon* of which Equilibration, may be illuſtrated by that propoſition of *Vitruvius*; *quæ corpora æqualia æqualiter & ſub uno diametro à centro diſtant; illa ſecant perpendicularem lineam ad angulos rectos:* And may be thus demonſtrated.

Let

Figure 1.

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Let two bodies of equal weight be placed, the one at A, the other at B, upon the Diameter of the Circle, whose Centre is at E; and neither of them shall move because their Gravity is equal at that distance from the Centre E; but supposing both to move, they shall hasten to the Centre of Gravity with equal velocity, because A and B make equal Angles with the Perpendicular D E C.

Necessary it is then, that in voluntary motion of a Member,

Member, æquilibrated by two Antagoniſt Muſcles of equal force, one of the oppoſite Muſcles overpower the other; not by its natural or ſpontaneous contraction which is equal on both parts; but by the *animal* force derived from the Brain, which makes the natural contraction greater, and the invigorate Muſcle to prevail: Whence it comes to paſs, that the Member, which before the acceſſion of the animal force was held unmoved, and as it were, ſuſpended betwixt two contrary equal powers; is determined to Motion according to the Command of the Will or Appetite. Which is much more elegantly expreſſed by *Galen* in theſe few words: *Æquipollens motus ipſius corporis Muſculorum fit, quando neuter tonum Animalem habet auxiliarem; non æquipollens verò, quando alter ſolus dominatur: Quare neceſſum eſt ut vincat contractio illius Muſculi, qui ab Animali facultate adjuvatur, de motu Muſculor. lib. 1. cap. 9.*

I obſerve *Secondly*, that in all voluntary motion of whatſoever Member, there are *two Terms* to be acknowledged: *One* is the part *quieſcent* or *fulciment*, to which the head of the acting Muſcle is faſtned; becauſe all motion is made upon ſomething that is at reſt, according to that Maxim of the Philoſopher: ἀνὶ μεταβάλλει τὸ κινούμενον, ἀπερειζόμενον πρὸς τὸ ὑποκείμενον αὐτῷ, *quicquid movetur, movetur ſuper aliquo, cui innititur.* The *other* is in the part *moved*, at the *inſertion* of the Muſcle moving, and from whence the ſame Muſcle doth, by contracting it ſelf, draw the Member toward it ſelf. And this is ſometimes leſs ſometimes more, elonged or remote from the Fulciment, according to the leſs or greater reſiſtance of gravity in the Member to be moved, and according to the leſs or greater vehemence required to the motion it ſelf. Which Nature (whoſe Art is not more admirable in any thing, than in proportioning the length of the Inſertion of every Muſcle, from the *Hypomochlion*

or point of Reſt, to the weight of the part thereby to be moved,) reſpecting, hath, with great ſagacity, ſupplied the little ſtrength of many ſlender Muſcles, by inſerting them at great diſtance from the Centre of their motion, or that point about which the Member whereto they belong, is to be moved. The *Reaſon* of which mechanical Contrivance ſeems to be this; that all ſuch remote inſertions, by ſubtracting part of the length of the Bone to be moved, ſubſtract alſo part of the weight of it, and ſo render the Muſcle able to countervail the remaining weight with leſs force. For, ſince there is no motion in the Centre, according to that propoſition in Mechanicks, *In centro omnis gravitas ceſſat, adeo ut neque grave, neque leve ad centrum deprehendatur:* We may eaſily underſtand, why in many Muſcles deſigned for ſtrong motions, the *Terminus ſtabilis* is farther elonged from the *Terminus mobilis*, than in others deſtined to motions leſs ſtrong, *viz.* that by even a ſmall force, the Muſcle (which conſidered in its proper bulk, or inſerted at leſs diſtance, would be inſufficient to the effect intended) might contrevail and elevate a great weight; as is exemplified in the Muſcles of the Hand, Arm, Thigh, and ſome other parts.

Whence that excellent Mathematician and Painter, *Lionardo da Vinci* of *Florence*, ſeems to have deduc'd that univerſal maxim of his, deliver'd in *Trattato de le Pittura, cap.* 199. Concerning the tardity and velocity of Animals in the motion of their Legs. *Quell' animale harà il "centro delle gambe ſuo ſoſtentacolo tanto più vicino al per- "pendicolo del centro della gravità, il quale ſarà di più tar- "di movimenti; e così di converſo, quello harà il centro de "ſoſtentacolo più remoto dal perpendicolo del centro della "gravità ſua, il quale ſia di veloce moto.*

Now this Reaſon may be both confirm'd and illuſtrated, by three *mechanick Propoſitions*; of which the firſt

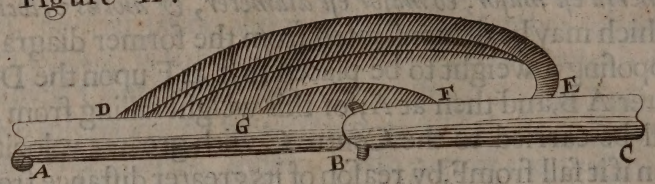
is

is this: *Omnis potentia motûs variatur ratione centri ad peripheriam.* The second is this, *Quò quid remotius à centro, eo velocius movetur:* The third this, *Quo circuli peripheria est major, eo major est diameter, & motus velocior.* Which may be demonstrated from the former diagram, supposing a weight to be placed first at F upon the Diameter A B, and then at A; for this weight falling from A, will be carried to the Centre C with greater velocity, than if it fall from F, by reason of its greater distance from E; the degrees of Velocity and consequently of facility of the motion, always holding proportion to the degrees of Elongation from the point of rest or Centre E.

For the same reason, (*viz.* to augment the force of some Muscles, considered simply without the advantage of Position) it was also that Nature has in many bones superadded to their ends, certain *Knobs* or *buttings* out, called *Epiphyses* and *Apophyses* to which the Muscles are fastned: Nor doth it seem to be of simple conveniency alone, that she has thus contrived the Originals of all great, and most other Muscles, higher or more elevated (more or less) than their insertions, but of absolute necessity: For

*First*, were the Head of any Muscle incumbent upon another, or upon any other sensible part, placed *lower* then its Tail or Tendon; the Muscle could not be contracted without manifest *pressure* and pain of the subjacent part. For demonstration sake,

Figure 11.

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Suppoſe A B to be the bone to be moved or pull'd upward, and B C to be another bone, upon which as the Fulciment or Reſt, the firſt is to be moved, and from which the two contiguous Muſcles D E, and F G ariſe; having their Heads at E F, and their Tails or Inſertions at D and G. I ſay then, that the contraction of the incumbent Muſcle D E, ſhall not preſs upon the ſubjacent Muſcle F G, becauſe the Head of it at E is raiſed higher than the Tail D. Whereas if we ſhould invert the poſition of the incumbent Muſcle, and make it lower at its Original E, than at its inſertion D; it could not poſſibly be contracted or abbreviated toward E, without preſſure of the ſubjacent Muſcle F G: which is an incommodity inconſiſtent with the Providence of Nature, and which ſhe has wiſely prevented by elevating the Heads of all incumbent Muſcles higher than their Inſertions.

*Secondly*, Had the Head of any Muſcle deſigned for the elevation of a bone, been placed upon the ſame *level*, or in a ſtreight line with the Tail of it; then could not the Muſcle have been contracted at all, nor conſequently could the bone, into which it is inſerted, have been rais'd upward;

upward, becauſe the *Fulciment* or Bone from which the head of the Muſcle ariſes, being in a direct line to the other Bone that is to be raiſed, and into which the Tail of the ſame Muſcle is inſerted; the ends of the two Bones muſt neceſſarily preſs one the other in a direct line, and by their mutual reſiſtance hinder the contraction of the Muſcle; as may be thus demonſtrated.

Figure III

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Let us imagine G H to be the Fulciment or immoveable Bone, and H I to be the other Bone, to be raiſed by the Muſcle K L, whoſe Original is at K on the firſt Bone, and Inſertion at L on the ſecond: Then becauſe the line K L is parallel to the lines G H, or the Original of the Muſcle K, upon the ſame level with its inſertion L; if the Muſcle pull toward K, the Bone H I muſt either penetrate the Bone G H, or oppoſe and wholly hinder the contraction of the Muſcle. But the penetration of one Bone by the head of the other being impoſſible, the contraction of the Muſcle muſt be impoſſible alſo, which is what I affirmed. Safely we may then conclude, that both to prevent preſſure of the ſubjacent parts, and to facilitate the contraction of the Muſcles themſelves; it

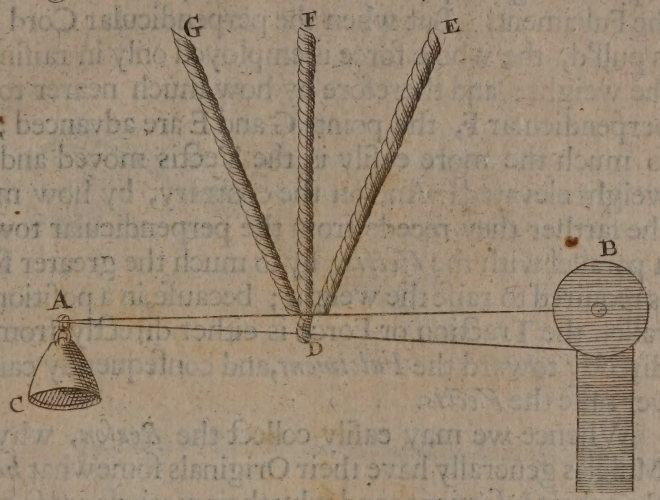
was

was of absolute necessity, that the Originals of all muscles destined to the motion of Bones, especially great and heavy bones, should be elevated above their insertions.

But Nature perhaps had yet another reason of this mechanick Artifice, which I conjecture to be this: Forasmuch as the use of all Muscles is to move the parts into which they are inserted, and that they cannot move those parts that stand in a direct Line with their Insertions, but by bringing them to make obtuse Angles with the Bone upon which they rest; and that obtuse Angles cannot be made by contraction of the muscles, unless their Originals be higher than their Insertions, as was just now demonstrated; therefore was it necessary they should be so framed: For where the Bone to be moved, is articulated in a direct Line with the Bone that remains quiet, as the Bones of the Limbs generally are, the movable Bone cannot possibly be moved, but it must make an Angle first more obtuse, and then less and less obtuse, until it come to a right Angle with the other Bone, that is the *Hypomochlion* or Rest. For the motion of a Bone made by contraction of a muscle, is but an Elevation or Translation of it from its former position in a right line with the superior Bone to which it is articulate, toward a perpendicular or right Angle with the same. And that Transition from a posture *direct* to a position *rectangular*, is made by Angles less and less obtuse successively betwixt the two Bones: And as for the *elevation* of a heavy Bone, by a muscle, in this manner; that cannot be effected, where the force moving is either in a line parallel to, or lower than the Bone to be moved (as hath been demonstrated.) But where the *movent* is superior or higher, and by how much the higher the *movent* power is placed above the bone to be moved, by so much more easily is the motion performed; as may be evinced by this *mechanick* Demonstration.

Let

Figure IV.

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Let A B represent a Vectis or Leaver, C a weight hung at the end of it under A, B the fulciment or rest, D F a perpendicular Cord, and D G and D E two other Cords, but oblique. I say then, that the weight C, and the end of the Vectis A, are much more easily or with less force lifted up by the perpendicular Cord D F, than by either of the oblique Cords D G and D E: For since the power placed at E draws by the line E D, when the Vectis A B is pulled toward its fulciment B, part of the power is employed

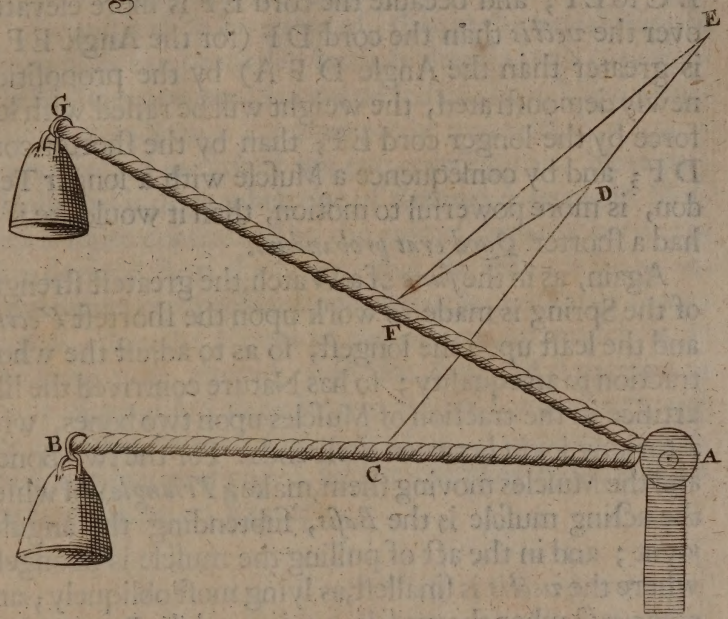
employed againſt the fulciment, the drawing of the oblique cord D E rather bringing the Vectis to bear againſt the Fulciment, than raiſing the weight C, and by conſequence a great part of the force is ſpent in vain upon the Fulciment. But when the perpendicular Cord F D is pull'd, the whole force is employed only in raiſing of the weight; and therefore by how much nearer to the perpendicular F, the points G and E are advanced; by ſo much the more eaſily is the Vectis moved and the weight elevated: And on the contrary, by how much the farther they recede from the perpendicular toward a parallel with the *Vectis*, by ſo much the greater force is required to raiſe the weight; becauſe, in a poſition parallel, the Traction or Force is either directly from, or directly toward the *Fulciment*, and conſequently can never raiſe the *Vectis*.

Whence we may eaſily collect the *Reaſon*, why the Muſcles generally have their Originals ſomewhat *higher* than their Inſertions; and why their motions are ſo much the ſtronger, by how much the higher their Heads are raiſed; which is what was to be inquired.

There is yet another *mechanick* artifice of Nature, both to facilitate and corroborate the force of Muſcles, deſigned to effect ſtrong motions or elevate weighty bones, and that is (as hath been before hinted) by prolonging their Tendons to greater length, than thoſe of other Muſcles: For although, to the ſuſtaining of a weight upon a *Vectis*, it be all one whether the ſuſtaining Cord be ſhorter or longer, provided the ſame degree of its advance toward a perpendicular be obſerved; yet to the elevation of it by traction, the traction of a *long* oblique cord, is more powerful than that of a *ſhort* oblique cord, which may be thus demonſtrated.

Imagine

Figure V.

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Imagine A B to represent a *Vectis* whose Fulciment is at A, and upon whose other end B a weight is hung; C D a shorter oblique cord, and C E a longer in the same degree of Obliquity. Now to the sustaining of this weight at the end of the *Vectis* B, both these oblique cords are equally accommodate, as being equally remote from a parallel with the *vectis*, according to the Angle D C A, or E G A. But as to the *raising* of the same weight, there is need of a less force to draw by the longer cord E C,

than to draw by the ſhorter cord D C; for let the *vectis* be raiſed from B to G, and the point C to F, and then the cord D C will be transferred to D F, and the cord E C to E F; and becauſe the cord E F is more elevated over the *vectis* than the cord D F (for the Angle E F A is greater than the Angle D F A) by the propoſition newly demonſtrated, the weight will be raiſed with leſs force by the longer cord E F, than by the ſhorter cord D F; and by conſequence a Muſcle with a longer Tendon, is more powerful to motion, than it would be if it had a ſhorter. *Quod erat probandum.*

Again, as in the *fuze* of a Watch, the greateſt ſtrength of the Spring is made to work upon the ſhorteſt *Vectis*, and the leaſt upon the longeſt, ſo as to adjuſt the whole traction to an equality; ſo has Nature contrived the like artifice in the traction of Muſcles upon two bones, with a turning joynt between their ends: For the two Bones, and the Muſcles moving them, make a *Triangle*; of which the acting muſcle is the *Baſis*, ſubtending the angular joynt; and in the act of pulling the muſcle is ſtrongeſt, where the *vectis* is ſmalleſt, as lying moſt obliquely; and *vice verſâ*, when the muſcle moving and the Bone moved, come to make a right Angle.

Theſe things being explained, I obſerve in the *Third* place, that no motion voluntary (nor indeed involuntary) can be effected, but the *Figure*, both of the muſcle moving, and of the member moved, muſt be at the ſame time *changed*: The *Reaſon* of which Neceſſity may be drawn from that well known Propoſition Geometrical of *Euclid*, *Angulos æquales in triangulis, æqualia latera ſubtendunt.*

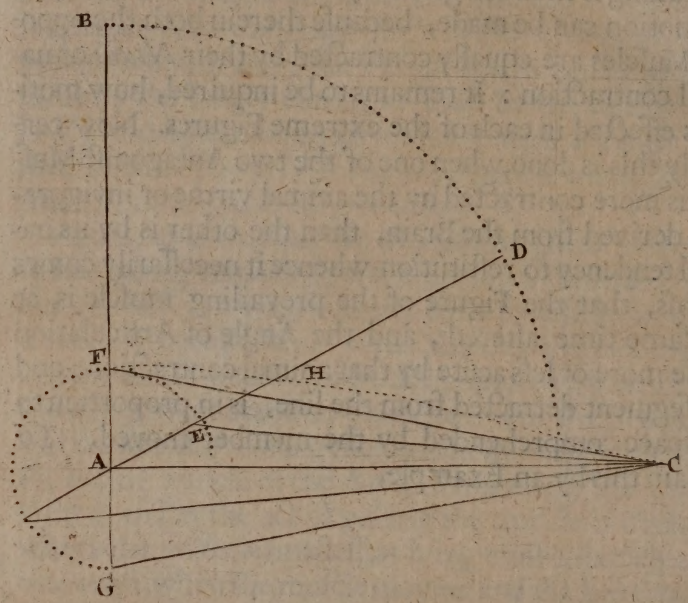
And becauſe the alteration of Figure depends on the alteration of Angles, therefore muſt we admit a triple Figure, according to the triple difference of Angles; namely a *Right*, in which neither of the two Antagoniſt

or

or oppoſite muſcles acteth; an *Obtuſe*, which being greater than a right, is conſequently ſubtended by a greater ſide; and an *Acute*, which being leſs than a right, requires a leſs ſubtending Line.

Taking it then for granted, that in the *middle* Figure no motion can be made, becauſe therein both the oppoſite Muſcles are equally contracted by their *Nixus* or natural contraction: It remains to be inquired, how motion is effected in each of the extreme Figures. Now certainly this is done, when one of the two Antagoniſt Muſcles is more contracted by the animal virtue or invigoration derived from the Brain, than the other is by its natural tendency to reſtitution; whence it neceſſarily comes to paſs, that the Figure of the prevailing muſcle is at the ſame time altered, and the Angle of Articulation made more or leſs acute by that animal contraction; and the ſegment detracted from the line, is in proportion to the ſpace comprehended by the member moved. To explain this by an Example,

Figure VI.

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Imagine the upper half of the Arm from the ſhoulder to the Elbow to be C A, and the Cubit or lower half from the Elbow to the Hand to be A B, the Muſcle bending the Arm to be C F, and its Antagoniſt extending the Arm to be C G, and the Object to be apprehended by the Hand at D. Now I ſay, while theſe two oppoſite Muſcles C F and C G, remain equally contracted, the Appetite muſt continue unſatisfied, *i. e.* the Hand cannot be brought up to lay hold of the Object deſired, becauſe

becauſe the Figure of the Arm, or Angle of Articulation is kept unchanged. But that the Hand may be raiſed to the object at D, it is neceſſary that Angle be made more *acute*, by a farther contraction of the Muſcle C F, and an extenſion of its Antagoniſt C G, in proportion to the motion of the Line B D ; and becauſe that Angle is leſs than the former right Angle, therefore is the ſide ſubtending it alſo proportionately leſs or ſhorter, according to the *Sixth Propoſition of the Firſt Book of* Euclid. Again, Since the Line or Arch E F, is in proportion to the Arch D B; it follows, that juſt ſo much is detracted from the length of the Muſcle bending the Arm: Not that ſo much is really defalk'd from the body of the Muſcle, becauſe then the Muſcle would be uncapable of Motion ever after; but only that by the animal contraction of its Fibres it is made ſo much ſhorter, the Line C F that was before ſtraight, being now changed into the Arch C H; which is what I propoſed to my ſelf to prove.

In the *Fourth* and laſt place I obſerve, that notwithſtanding this alteration of the Figure of a Muſcle by its contraction, yet is not the belly of it *ſwell'd* or *augmented* in bulk, as hath been believed by all, who held the Muſcles when they act, to be inflated as it were by a Gale of Animal Spirits immitted into them from the Brain: But on the contrary rather *leſſened*, as may appear from the *Experiment* deſcribed by Dr. *Gliſſon (de Ventric. & Inteſtin. cap.* 8. *numer.* 9.) which is this.

Let there be provided a Tube of Glaſs, in length and bore capacious enough to hold a mans Arm; and to the upper Orifice of it on the outſide, affix another Tube of Glaſs of about an Inch Diameter in the Bore, ſhaped like a common Weather-glaſs, only with a wide mouth like a Tunnel; ſo as the lower end may open into the greater Tube whoſe bottom is firmly ſtopp'd: Then having

erected both Tubes, let a Man of ſtrong and brawny Muſcles thruſt his whole naked Arm into the greater Tube up to the very Shoulder, about which the Orifice of the Glaſs muſt be cloſely luted, that no water may flow out that way. This done, let as much water be poured in by the Tunnel as both Glaſſes will receive, leaving only a little ſpace at the top of the leſſer, empty. In fine, let the man ſtrongly vigorate all the Muſcles of his Arm by clinching his Fiſt, and relax them again by turns; and you ſhall obſerve that when he vigorates his Muſcles, the water in the leſs Tube will ſink ſomewhat lower, but riſe again when he relaxes them: Whence it is evident, that the Muſcles do not ſwell up, nor are inflated at the time of their invigoration or acting; but rather are minorated and contracted in all their three dimenſions, otherwiſe the water would at that time, not deſcend, but aſcend in the Neck of the Tunnel. Good reaſon then had Dr. *Lower* to affirm, *(lib. de corde c.2. pag.76.) Muſculum in omni motu* [*voluntario*] *admodum arctè, & in ſeſe introrſum conſtringi, minorari, & durescere; adeóque motu inflationi prorſus contrario moveri.*

There is then (it ſeems) no neceſſity of any influx of Animal or Vital Spirits, to puff up the Muſcles when they act; but that their Fibres, invigorated by motion begun in the Brain, perform their work by ſimple *abbreviation*. But how this abbreviation can be made, without augmentation of the Muſcles, either *ſecundum latitudinem*, or *ſecundum profunditatem*, or *ſecundum utramque*, in proportion thereunto; ſeeing that all *tenſile* Bodies have ſomewhat more of depth, or breadth, or both, when they are contracted, than when they ſuffer extenſion in length: This (I confeſs) I do no more comprehend, than I do how the Soul cauſeth the Abbreviation it ſelf. To ſay with Dr. *Gliſſon*, *Muſculorum Fibres proprio vitali motu ſe abbreviare*; ſeems to me rather to farther

farther intangle, than untie the Gordian knot; amusing us with the Hypothesis of *Natural Perception*, and yet not solving the difficulty here pressing us, *viz.* how the Fibres lose somewhat of all their dimensions, in the act of their Contraction or Abbreviation. Leaving therefore this Problem to the consideration of wiser Heads than mine, and sitting down content with my Ignorance, lest I should farther expose it, I hast to a Conclusion.

Reflecting upon what hath been said, we may easily understand, why most Muscles have their proper *Antagonists*, there being *contrary* motions to be successively performed by every Member, and it being impossible that one and the same Instrument should serve to *both*. Of these Antagonists, one *bends* the member by being it self contracted; the other *extends* it again by being in like manner contracted successively, and both extend each other alternately. The contracted Muscle always *acteth*, the extended always *suffers*, and is transferred with the part moved.

Some Muscles there are that have no Antagonists, because they need none, such are all *circular* Muscles, the reason of whose motion is very obvious: For, having circular Fibres, and all contraction being necessarily made *secundum continuitatem lineæ*; 'tis most evident, that all Muscles of that figure close or draw together the parts to which they are affixt, by contraction of their Fibres toward their Centre, as is exemplified in the *Sphincters* of the Bladder and Fundament, and in the *shutter* of the Eyelids.

Nevertheless it may be inquired, why the Sphincters have no Antagonists, when to the *clausor palpebrarum* is opposed the *Elevator?* The *reason* of which difference seems to be this, that the neck of the Bladder and the Fundament are forced open, not by Muscles, but by the excrements themselves, which being strongly pressed

downward by the Midriff and the Muſcles of the *Abdomen*, thruſt open the ſphincters by extending their circular Fibres from the Centre to the Circumference; ſo that in ſtrictneſs of truth, the excretion of the Urine and excrements of the Guts, is not an action altogether and immediately *voluntary*, as the cloſing of the Eyelids is.

And this is all the ſhortneſs of my time permits me to ſay at preſent, concerning the *mediate* and *immediate Inſtruments* of voluntary motion, concerning their common *differences*, and concerning the *reaſon* and *manner* of their Actions in general. If in my devoir, to explain ſome few of the many Geometrical and Mechanical contrivances of Nature in the Fabrick of the Muſcles, both to facilitate their motions and to augment their Forces; I have not ſo well acquitted my ſelf as the Argument deſerves, and as ye expected; I muſt intreat you to believe, that what I have adventur'd to deliver touching this Theme, extremely abſtruſe in it ſelf, nor yet ſufficiently handled by any man; was deſigned only as an *Eſſay*, rather to excite the Induſtry, than to preſcribe to the curioſity of the more perſpicatious and more learned, to whoſe judgment mine ſhall be always ready to Conform. Mean while I content my ſelf with this hope, that what hath now been ſaid, may ſuffice to raiſe up the minds of my Auditors to a juſt and pious admiration of the infinite Wiſdom of our Omnipotent CREATOR, all whoſe works both in the greater World and in the leſs, the Body of Man, are moſt exactly adjuſted by *number*, *weight*, and *meaſure*. *How manifold are thy works, O Lord, in Wiſdom haſt thou made them all.* *Pſal.* 104. *v.* 24. ¶

EPI-

## EPIPHONEMA.

*I Nunc, quisquis Assecla es* Epicuri, *& dic, casu id factum, quod non potuerit fieri* sapientius: *quodque si factum aliter fuisset, in hunc ipsum quo jam se habet modum, ut rectè haberet, necessariò restituendum fuisset. Scilicet, ut tibi casu factum detur, finge saltem fieri debuisse ex* industria ; *& agnoscesfieri non potuisse præclariùs ; agnoscendumque idcirco industrium potius* Artificem, *quàm temerariam* fortunæ *manum.*

*Quid de* Humano *ulteriùs corpore, quod jam dissectum hic, & ad intima usque* vitæ sensusque *penetralia recluſum vidisti, dicam ? Cum illius ne una quidem pars sit, in qua ubi molem, substantiam, formam, connexionem, situm, ac officium simul usùmve consideraveris ; esse te captum mente oporteat, nisi extemplò agnoscas, nihil esse fortuitum, nihil non provisum, nihil non à solertissima sapientissimaque* mente *destinatum. Ac si una quidem, alteravè aut paucæ tantum essent partes, ex quibus foret corpus hominis ; tum esset fortassis minùs obstupescendum. At verò esse in ipso, ac una sub cute,* varietatem *propè infinitam partium inter se commistarum,* durarum *cum* mollibus, solidarum *cum* cavis, quiescentium *cum* motis, fixarum *cum* fluentibus, excipientium *cum* subeuntibus, *&c. ac nullam tamen nulli esse vel minimo obstaculo ; quinimò mutuas esse vices, coadjuvantesque operas ; & sic quidem ut si cujusquam magnitudinem augeas, vel imminuas, si figuram mutes, si cohæsionem solvas, si situm invertas, si in tota demum machina quid moveas : tum omnia pejùs habitura, vel etiam pessum ruitura sint ; quomodò id tandem* stuporem *non creet ? Horum equidem cogitatione adeò mihi confusum esse animum sentio, ut æquum sit, imo planè necessum hic conticescam.*

*Mentis enim vocisque meæ præcluditur usus.*

*Nihil vos moramur, Patres conscripti ; discedite.*

FINIS.

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